Draft

Sampling and Analysis Plan

for the

Diamond Head Oil Superfund Site, Kearny, New Jersey

Prepared for:
U.S. Environmental Protection Agency
Region II
290 Broadway, New York

Prepared by:

CH2MHILL

99 Cherry Hill Road
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Prepared under:
Response Action
Contract No. 68-W6-0036
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February 2003

DRAFT
SAMPLING AND ANALYSIS PLAN

Consisting of a
QUALITY ASSURANCE PROJECT PLAN
and a
FIELD SAMPLING PLAN
for
THE DIAMOND HEAD OIL SITE RI/FS

Kearny, Hudson County, New Jersey, 07032-4310

February, 2003

Prepared by:

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LIST OF EXHIBITS

ATTACHMENTS

DISTRIBUTION OF SAP

EPA Work Assignment Manager - Ms. Grisell V. Diaz-Cotto

EPA QA Officer - Mr. Sergio Lopez

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CH2M HILL Remedial Investigation Lead – Mr. Andy Judd

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ACRONYMS AND ABBREVIATIONS

%R	Percent Recovery
95% UCL	95 Percent Upper Confidence Limit
ARAR	Applicable or Relevant and Appropriate Requirements
AST	Above Ground Storage Tank
ASTM	American Society of Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BOD	Biological Oxygen Demand
CFAM	Contract Financial Administrative Manager
CLASS	Contract Laboratory Analytical Services Support
CLP	EPA's Contract Laboratory Program
CO	Contract Officer
COC	Chain of Custody
COD	Chemical Oxygen Demand
COPC	Constituent of Potential Concern
CRP	Community Relations Plan
DCMC	Defense Contractor Material Command
DESA	EPA's Division of Environmental Science and Assessment
DI	Deionized
DMP	Data Management Plan
DNAPL	Dense Non-Aqueous Phase Liquid
DOT	US Department of Transportation
DQOs	Data Quality Objectives
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESI	Expanded Site Inspection
FCRs	Field Change Requests
FI	Field Investigation
FIT	Field Investigation Team
FS	Feasibility Study
FSP	Field Sampling Plan
FTL	Field Team Leader
GC	Gas Chromatograph
GPR	Ground Penetrating Radar
GPS	Geographical Positioning System
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HMDC	Hackensack Meadowlands Development Commission
HSO	Health and Safety Officer
HSP	Health and Safety Plan
IDW	Investigation Derived Waste
IRIS	Integrated Risk Information System
LCS	Laboratory Control Sample
LDL	Low Detection Level
LNAPL	Light Non-Aqueous Phase Liquid
MCAWW	Methods for Chemical Analysis of Water and Wastes
MDL	Method Detection Limit

MPR	Monthly Status Report
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPL	Non-Aqueous Phase Liquid
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NPL	National Priorities List
NTU	Nephelometric Turbidity Units
OVA	Organic Vapor Analyzer
PARCC	Precision, Accuracy, Representativeness, Comparability, Completeness
PCB	Polychlorinated Biphenyl
PCE	Project Controls Engineer
PCR	Property Control Representative
PE	Polyethylene
PGM	Program Manager
PID	Photoionization Detector
PM	Project Manager
PO	Project Officer
PP	Project Planning and Support
PPM	Parts Per Million
PR	Purchase Requisition
PRG	Preliminary Remediation Goal
PSE&G	Public Service Electric & Gas Company
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RA	Remedial Action
RA	Risk Assessment
RAC	Response Action Contract
RAS	Routine Analytical Service
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RI	Remedial Investigation Leader
ROD	Record of Decision
RPD	Relative Percent Difference
RSCC	Regional Sample Control Center
RSD	Relative Standard Deviation
RTL	Review Team Leader
SAP	Sampling and Analysis Plan
SD	Standard Deviation
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SSL	Soil Screening Level
SVOC	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure

TDS	Total Dissolved Solids
TM	Technical Memorandum
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USACE	US Army Corps of Engineers
VOC	Volatile Organic Compound
WA	Work Assignment.
WAM	Work Assignment Manager
WP	Work Plan

Project Name: Diamond Head RI/FS

QAPP Reviewed By: Juliane [illegible]

Date: Jan 29, 2003

QAPP REVIEW CHECKLIST

QAPP ELEMENTS	QA/R-5 ELEMENT	Y/N	NA	COMMENTS
Title and Approval Sheet	A1	Y		p. 1
Title		Y		p. 1
Organization's name		Y		p. 1
Dated signature of project manager		Y		
Dated signature of quality assurance officer		Y		To be provided on final
Other signatures, as needed		Y		Same
Table of Contents	A2	Y		p 2
Problem Definition/Background	A5	Y		Section 1 p 10-14
Clearly states problem or decision to be resolved		Y		Sections 1 and 3
Provides historical and background information		Y		Section 1
Project/Task Description	A6	Y		Section 4, Exhibit 5
Lists measurements to be made		Y		Section 4, Exhibits 5,7,8
Cites applicable technical, regulatory, or program-specific quality standards, criteria, or objectives		Y		Sections 3 and 4
Notes special personnel or equipment requirements		Y		Section 2 & Att A
Provides work schedule		Y		Exhibit 11
Notes required project and QA records/reports		Y		Section 5
Project/Task Organization	A4			
Identifies key individuals, with their responsibilities (data users, decision makers, project QA manager, subcontractors, etc.)		Y		Section 2, Exhibit 4
Organization chart shows lines of authority and reporting responsibilities		Y		Exhibit 4
Documentation and Records	A9			
Lists information and records to be included in data report (e.g., raw data, field logs, results of QC checks, problems encountered)		Y		Section 5, SOP 5, Section 11, Att E
States requested lab turnaround time		Y		Exhibit 9, Att E
Gives retention time and location for records and reports		Y		Section 14

Project Name: Diamond Head RI/FS **Date:** Jan 29, 2003

QAPP Reviewed By: Juliane Test

QAPP REVIEW CHECKLIST

QAPP ELEMENTS	QA/R-5 ELEMENT	Y/N	NA	COMMENTS
Quality Objectives and Criteria for Measurement Data	**A7**	/		Section 3
States project objectives and limits, both qualitatively and quantitatively		Y		Section 3
States and characterizes measurement quality objectives as to applicable action levels or criteria		Y		Section 3
Sampling Process Design (Experimental Design) States the following:	**B1**	Y		Section 4, Exhibit 5
Type and number of samples required		Y		Same
Sampling design and rationale		Y		Same
Sampling locations and frequency		Y		Same
Sample matrices		Y		Same
Classification of each measurement parameter as either critical or needed for information only		Y		Y Sections 3 and 4 classify data as screening and definitive
Appropriate validation study information, for nonstandard situations		Y		Sections 6 and 7
Sampling Methods Requirements	**B2**	Y		Section 4 and Att B with SOPs
Identifies sample collection procedures and methods		Y		Att. B SOPs
Lists equipment needs		Y		Att B SOPs
Identifies support facilities		Y		Att A Site Mgmt Plan
Identifies individuals responsible for corrective action		Y		Section 11
Describes process for preparation and decontamination of sampling equipment		Y		Att B SOP
Describes selection and preparation of sample containers and sample volumes		Y		Att B SOPs
Describes preservation methods and maximum holding times		Y		Att B SOPs
Special Training Requirements/Certification Listed	**A8**	Y		Section 12
States how provided, documented, and assured		Y		Section 12
QAPP ELEMENTS	**QA/R-5 ELEMENT**	**Y/N**	**NA**	**COMMENTS**
Sample Handling and Custody Requirements	**B3**	Y		Section 5 and Att B SOPs

Project Name: Diamond Head RI/FS **Date:** Jan 30 2002
QAPP Reviewed By: Juliana Hess

QAPP REVIEW CHECKLIST

Notes sample handling requirements		V		Att B SOPs
Notes chain-of-custody procedures, if required		V		Section 5 and Att B SOPs
Instrument Calibration and Frequency	**B7**			
Identifies equipment needing calibration and frequency for such calibration		V		Att B SOPs
Notes required calibration standards and/or equipment		V		Same
Cites calibration records and manner traceable to equipment		V		Same
Analytical Methods Requirements	**B4**	V		Section 3, Exhibits 6,7,8,
Identifies analytical methods to be followed (with all options) and required equipment		V		Same
Provides validation information for nonstandard methods		V		Same
Identifies individuals responsible for corrective action		V		Section 11
Specifies needed laboratory turnaround time		V		Exhibit 9, Att E
Data Review, Validation, and Verification	**D1**	V		Section 7 and Att D Data Mgmt Plan
States criteria for accepting, rejecting, or qualifying data		V		Section 3, Exhibit 6
Includes project-specific calculations or algorithms		V		Att D Data Mgmt Plan
Validation and Verification Methods	**D2**	V		Sections 3 and 7
Describes process for data validation and verification		V		Same
Identifies issue resolution procedure and responsible individuals		V		Section 11
Identifies method for conveying these results to data users		V		Att D Data Mgmt Plan
QAPP ELEMENTS	**QA/R-5 ELEMENT**	**Y/N**	**NA**	**COMMENTS**
Data Acquisition Requirements for Nondirect Measurements	**B9**			
Identifies type of data needed from nonmeasurement sources (e.g., computer databases and literature files), along with acceptance criteria for their use		V		Att D Data Mgmt Plan
Describes any limitations of such data		V		Same
Documents rationale for original collection of data and its relevance to this project		V		Section 3

Project Name: Diamond Head RI/FS **Date:** Jan 29, 2002

QAPP Reviewed By: Juliane ...

QAPP REVIEW CHECKLIST

QAPP ELEMENTS	QA/R-5 ELEMENT	Y/N	NA	COMMENTS
Data Management	**B10**			
Describes standard record-keeping and data storage and retrieval requirements		√		Att D Data Mgmt Plan
Checklists or standard forms attached to QAPP		√		Att B SOPs, Section 5
Describes data handling equipment and procedures used to process, compile, and analyze data (e.g., required computer hardware and software)		√		Att D Data Mgmt Plan
Describes process for assuring that applicable Office of Information Resource Management requirements are satisfied		√		Att D
Quality Control Requirements	**B5**			
Identifies QC procedures and frequency for each sampling, analysis, or measurement technique, as well as associated acceptance criteria and corrective action		√		Sections 3 and 8
References procedures used to calculate QC statistics including precision and bias/accuracy		√		Sections 3 and 8
Assessments and Response Actions	**C1**			
Lists required number, frequency and type of assessments, with approximate dates and names of responsible personnel (assessments include but are not limited to peer reviews, management systems reviews, technical systems audits, performance evaluations, and audits of data quality)		√		Section 11
Identifies individuals responsible for corrective actions		√		Sections 2 and 11
QAPP ELEMENTS	**QA/R-5 ELEMENT**	**Y/N**	**NA**	**COMMENTS**
Instrument/Equipment Testing, Inspection, and Maintenance Requirements	**B6**			
Identifies acceptance testing of sampling and measurement systems		√		Section 9 and 10
Describes equipment preventive and corrective maintenance		√		Same
Notes availability and location of spare parts		√		Same
Inspection/Acceptance Requirements for Supplies and Consumables	**B8**			
States acceptance criteria for supplies and consumables		√		Same
Notes responsible individuals		√		Same and Section 2

Project Name: Diamond Head RI IFS **Date:** Jan 29, 2003
QAPP Reviewed By: Juliane Kerr

QAPP REVIEW CHECKLIST

Reconciliation with User Requirements	**D3**			
Describes process for reconciling project results with DQOs and reporting limitations on use of data		V		Sections 7, 13 and ~~Att D~~ Data Mgmt Plan
Assessments and Response Actions	**C1**			
Lists required number, frequency and type of assessments, with approximate dates and names of responsible personnel (assessments include but are not limited to peer reviews, management systems reviews, technical systems audits, performance evaluations, and audits of data quality)		V		Section 2 and 13
Identifies individuals responsible for corrective actions		V		Same
Distribution List	**A3**	V		p 6
Reports to Management Identifies frequency and distribution of reports for:	**C2**	V		Sections 11, 13 and ~~Att A~~ Site Mgmt Plan
Project status				Same
Results of performance evaluations and audits				Same
Results of periodic data quality assessments				Same
Any significant QA problems				Same
Preparers and recipients of reports				Same

1.0 INTRODUCTION

The Sampling and Analysis Plan (SAP) contained in this document represents the combined Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) for the Remedial Investigation (RI) to be undertaken by CH2M HILL at the Diamond Head Oil site in Kearny, Hudson County, New Jersey.

CH2M HILL is submitting this SAP to the US Environmental Protection Agency (EPA), Region II, in response to Work Assignment (WA) No. 112-RICO-02KK under Response Action Contract (RAC) No. 68-W6-0036.

This SAP (1) describes the sampling activities to be performed during the Diamond Head Oil site RI and (2) defines the quality assurance (QA) and quality control (QC) procedures to be followed during these activities. The objectives of this SAP are therefore, to ensure the integrity of the performed sampling and that the collected data are of the appropriate type and quality for their intended use. This plan has been prepared and reviewed using the EPA Requirements for Quality Assurance Project Plans - EPA QA/R-5 (EPA, March 2001) as a guidance document and includes all QAPP components described in EPA QA/R-5. A completed EPA QA/R-5 Review Checklist is provided at the beginning of this document and indicates the sections in this plan where the various EPA QA/R-5 components are described.

Specifically, this SAP describes the following:

- The Diamond Head RI/FS project
- Organization and responsibilities of project personnel including the anticipated subcontracts
- Project objectives, including overall RI/FS objectives and Data Quality Objectives
- Sampling program and procedures
- Sample management including sample nomenclature, packaging and shipping, and documentation
- Planned analytical program
- Analytical data handling, validation and reporting
- QA/QC requirements
- Calibration and maintenance of instrumentation
- Requirements for supplies and consumables
- Assessment of project performance and corrective actions
- Training of project staff
- Reports to Management

The broad objectives of the Diamond Head Site RI/FS are to obtain data on the nature and extent of soil and groundwater contamination associated with the site, assess the associated human health risks, and evaluate appropriate remedial alternatives. The specific RI/FS objectives for each medium are identified in Section 3 and were developed based on observations during the initial site visit, current site conditions, available information on past activities and suspected source areas, and available soil and groundwater contamination data.

1.1 SITE LOCATION AND DESCRIPTION

The Diamond Head Oil site is currently inactive and consists of approximately 15 acres of undeveloped land located near the Hackensack Meadowlands. Exhibit 1 shows the location of the site; Exhibit 2 is a site plan, which also shows the locations where samples were collected during the last two site investigations. The property is currently owned by the Hudson Meadows Development Corporation.

The site is bordered on the north by Harrison Avenue, on the east by the entrance ramp of I-280, on the south (and east) by a drainage ditch bordering I-280, and on the west by a salvage operation. The area surrounding the site is industrial; there are no residential areas in the vicinity of the site. A well survey performed as part of the Hazard Ranking System (HRS) documentation package concludes that there are no public supply wells within four miles of the site.

The site is flat over the east section – where a former reprocessing area / AST farm / lagoon were located - and over the west section between an on-site landfill and the Public Service Electric and Gas (PSE&G) Company right-of-way. A change in elevation of approximately 10 to 15 feet above the east and west sections of the site demarcates the boundary of the landfill.

At the time of the initial site visit in May, 2002, standing water was present over small areas in the east section of the site although there was evidence of flooding over larger portions of the site. The ground in those areas was noted to be soft. There was no apparent sheen on the standing water. At the time of the second site visit in January 2003 in preparation for the start of the RI activities, the majority of the southern section of the site was flooded by 2 to 8 inches of water with soft ground over the majority of the rest of the site.

At the time of the first site visit, an oil sheen was seen along the bank of the drainage channel immediately downgradient of the site at the south border of the PSE&G right-of-way. There was no sheen on the standing water in the drainage ditch, which appeared not to be flowing.

Approximately 70 percent of the site is currently covered by Phragmites up to 12 feet tall, which make access difficult. On aerial photographs from 1990, a wetland area is observed to have developed in the southern section of the site where part of the former lagoon was located and had been filled during the construction of I-280. A wetland delineation study performed in 1990 and included in the HRS documentation package for the site confirmed the presence of two small wetland areas in the southern portion of the site. The study concluded, however, that the previous historical degradation of the site has severely affected the limits and the quality of these habitats. One of the wetland areas is completely surrounded and impacted by fill with the other area displaying similar disturbance and utilized primarily as a drainage swale for I-280 and surrounding street and industrial property runoff. There are currently no markings at the site to indicate the limits of these wetland areas.

1.2 SITE HISTORY

The Diamond Head Oil site is a former oil reprocessing facility, which was in operation from February 1, 1946 to early 1979. During its operations, multiple aboveground storage tanks (ASTs) and possibly in-ground pits (lagoons) were used to store oily wastes. These wastes were intermittently discharged directly to adjacent properties to the east and the wetland area on the south side of the site, creating an oil lake. The following three areas of operations, the outlines of which are currently still visible at the site, developed over the years:

- A landfill – with an approximate area of 7 acres
- The oil reprocessing section of the site – with 2 buildings, multiple ASTs, drum storage areas, associated piping, and possibly in-ground pits (lagoons)
- An oil lagoon –with an approximate area of 5 acres located over the south section of the site and extending outside the site boundaries to the east and south

In 1968, the New Jersey Department of Transportation (NJDOT) acquired the property to the south of the site. In 1977, when beginning construction of Interstate 280 (I-280), NJDOT reportedly removed nine million gallons of oil-contaminated water and five to six million cubic yards of oily sludge from the oil lagoon. It is also reported that during the I-280 construction, an underground "lake" of oil-contaminated groundwater was found extending from the eastern limits of the I-280 right-of-way to Frank's Creek to the west of the site. During the process of constructing I-280, the entire oil lagoon was apparently filled, as it no longer appears on post I-280 construction-aerial photographs. There is no information on the oil and sludge removal from the lagoon and whether the excavation was completed to the native soils prior to filling or whether a sludge layer was left at the bottom of the lagoon.

From the close of operations in 1979 until 1982, the abandoned site was not completely fenced. During this time, it was reported that dumping of oily wastes and other debris took place at the site. Eastern Chemical Co. was hired to clean up the site in May 1982. In order to do so, the materials in the tanks were analyzed and found to contain polychlorinated biphenyls (PCBs) at a concentration of 206 parts per million (ppm). Subsequent analyses of the same materials revealed the presence of PCBs at concentrations of over 3,300 ppm. Approximately 7,500 gallons of materials were apparently pumped out of the tanks and disposed off-site. In the same time frame, an additional 27 tons of contaminated soil were apparently removed from the site. Finally, aerial photographs from 1982 show that the reprocessing infrastructure of the site had been dismantled.

The current owner of the site is the Hackensack Meadowlands Development Commission (HMDC); HMDC's preliminary long-term plans are to develop the site for an office building.

1.3 GEOLOGY AND HYDROGEOLOGY

Site geology (based on several shallow borings installed at the site during previous investigations) consists of varying thickness of fill materials overlying native sands and clays. A layer of peat and/or organic silt and clay is present in most borings at 14 to 18 feet below the ground surface. The groundwater table is shallow at approximately 1 to 2 feet below the ground surface. Previous investigations conducted at the site suggest that groundwater flow is to the west. At the time of the site visit, 0.6 feet of free product were measured in monitoring well MW-3 located in the former lagoon area; product had also been noted in this well during previous investigations conducted at the site. Two other wells MW-5 in the landfill area and MW-2 in the northeast portion of the site were checked for free product during the site visit and were found not to contain any.

1.4 SUMMARY OF EXISTING DATA

Four previous investigations have been conducted at the site including a sampling event conducted by the New Jersey Department of Environmental Protection (NJDEP), an

Environmental Site Characterization conducted by Killam Associates, and two Site Inspections conducted by EPA's Region 2 Field Investigation Team (FIT).

During these investigations, groundwater, surface water, sediment, surface/subsurface soil, liquid waste, and solid waste samples were collected. Analytical results of these samples indicated the presence of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, PCBs, and metals in the various sampled media.

Because the analyses of the samples collected by NJDEP and Killam Associates were performed outside of EPA's Contract Laboratory Program (CLP), the results were not validated, and the locations of some of the samples are unknown. The results from these two sampling events are used as an indication of the presence of contamination at the site and to assist in developing the scope for this remedial investigation. These results will not be used to perform the ecological and human health risk assessments or to support the RI/FS decision-making process.

The scope of the two investigations performed by EPA and how their results will be used during this investigation are described below.

EPA 1991 Site Inspection

As part of a 1991 Site Inspection, EPA collected four groundwater, three surface water, three sediment, seven surface soil, one subsurface soil, three liquid waste, and two solid waste samples. Although the exact locations are unknown, the general locations of the conducted sampling are known. Samples were analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) metals and indicated the presence of both organic contaminants and metals at the sampled locations.

The analyses were performed by EPA CLP laboratories and the results were validated. The actual laboratory packages were not available at the time of the preparation of the Work Plan and this SAP but will be obtained, reviewed to determine the quality and usability of the data, and used to perform the ecological and human health risk assessments and support the RI/FS decision-making process. Although the exact sampling locations are unknown, the general area where the samples were collected is known. Since the site has been subject to filling and grading during its active life, contamination within a general area (e.g., landfill area, former reprocessing facility area) is expected to have been spread within that area and be similar within the area. Additional survey information for the sampling points would improve the usability of the data. The previous contractor project files will be reviewed for any available survey information.

EPA 1999 Expanded Site Inspection

In December 1999, EPA conducted an Expanded Site Inspection (ESI) at the site, which included the installation of 20 soil borings within the reprocessing/lagoon section of the site. Samples were collected from 0 to 2 feet and at a lower depth within each boring. EPA also collected 15 sediment samples from the on-site wetland areas as well as 3 samples from an off-site wetland area, which may be representative of background conditions. The general locations of the on-site samples are shown on Exhibit 1. Three groundwater samples and samples from the product in well MW-3 were also collected. The samples were analyzed for TCL organics and TAL metals and indicated the presence of both organic contaminants and metals at the sampled locations.

All analyses were performed by EPA CLP laboratories and the results were validated. Although the laboratory packages for the soil data were not available at the time of the preparation of the Work Plan and this SAP, the validated data packages for the sediment samples were available. The CH2M HILL project chemist reviewed these data packages and determined that the results are of useable quality subject to the assigned validation qualifiers. The soil results of the 1999 ESI will be also obtained as part of this RI/FS and reviewed to determine the quality and usability of the data. All 1999 data will then be used to perform the ecological and human health risk assessments and support the RI/FS decision-making process. Although the exact sampling locations are unknown, the general areas where the samples were collected are known. Since the site has been subject to filling and grading, contamination within a general area (e.g., landfill area, former reprocessing) is expected to be similar. Additional survey information for the sampling points would improve the usability of the data. The previous contractor project files will be reviewed for any available survey information.

Previous data will be tabulated and plotted as soon as it is received from the contractor who performed the work . A review and evaluation of these data is included in the Scope Of Work for the Phase I RI. Because these activities are not related to on-site sampling, they are not discussed further in this document. Brief summaries of the work that was performed during each previous investigation are provided in Section 1.0 of the RI/FS Work Plan (CH2M HILL, December 11, 2002).

1.5 POTENTIAL SOURCE AREAS

Based on existing information on historical site activities (including an analysis by the EPA of historical aerial photographs), observations made during the initial and subsequent site visits, and the existing site contamination data, the following potential source areas were identified at the site:

1) A former "lake" of oily wastes that covered approximately 5 acres in the southern portion of the Diamond Head property and extended off-site to the east.
2) Up to 6 former impoundments (lagoons or sludge ponds) for oily waste products that covered an area of approximately 5 acres located in the southern portion of the site (the source of the oil lake).
3) A potential "plume" of oily free-product LNAPL floating on top of the groundwater table observed at existing monitoring well MW-3.
4) The former AST farm, drum storage areas, and associated piping located to the south of the former oil reprocessing building.
5) A landfill that occupies approximately 7 acres of the site and contains materials of unknown nature or origin.

2.0 PROJECT ORGANIZATION AND PERSONNEL RESPONSIBILITIES

An organization structure has been developed to identify the roles and responsibilities of the various personnel and organizations involved with the project. The organizational structure for this project includes EPA, CH2M HILL, and subcontractors for vegetation clearance, surveying, utility clearance, boring and monitoring well installation, downhole geophysical logging, and laboratory services. Laboratory services will be provided by EPA Contract Laboratory Program (CLP) laboratories for analyses available through this program and subcontractor laboratories for analyses not available through this program. The analyses performed through CLP will be used for characterization of site contamination, evaluation of the human health and ecological risks posed by the site, and engineering evaluation of remedial alternatives. The analyses performed outside of the CLP will be for soil geotechnical parameters, groundwater general chemistry parameters, and characterization of free product found at the site. These results will be used in the engineering evaluations of remedial alternatives. A project organization chart is presented as Exhibit 4.

The following describes the CH2M HILL project team and its individual responsibilities:

- The Program Manager, Al Sloan, is responsible for the overall quality of the work performed at the site, and has final responsibility for the management of the RAC program.

- The Project Manager (PM) is Juliana Hess. She has primary responsibility and authority for:

  - Implementing and executing the technical, quality and administrative aspects of the project, including the management of the project team.
  - Maintaining the SAP (including QAPP and FSP) and ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including the Work Plan, this SAP, and the Health and Safety Plan (HSP).
  - Communicating all technical, QA and administrative matters to the EPA.
  - Documenting any deviations from the approved Work Plan, this SAP, and the HASP in Field Change Requests (FCRs) forms and in the monthly progress reports and communicating these to the EPA for approval.
  - Procuring subcontractors who have the appropriate qualifications to provide the required services.
  - Supporting the RI Lead and Field Team Lead (FTL) during the filed activities.

- The site-specific Health and Safety Officer will be a member of the CH2M HILL on-site field team who will have the responsibility for the implementation of the Health and Safety Plan while on-site activities are underway. This will include monitoring the work environment in accordance with the requirements in the plan and recording the results of this monitoring.

- The RI Lead is Andy Judd. The RI Lead reports directly to the PM and will be supported by the Field Team Lead and by field technical staff who will perform the RI activities. The RI Lead will be responsible for:

- Implementing the field investigation.
- Monitoring the quality and timeliness of all RI activities, including those performed by subcontractors.
- Implementing the Work Plan and SAP in order to ensure that the acquired data meet the data quality objectives.
- Verifying the qualifications of suppliers and subcontractors relative to project objectives and special requirements, and advising staff and subcontractors of their roles and responsibilities towards achieving the project objectives.
- Ensuring that all field staff possess the appropriate training prior to collecting environmental samples and that staff and subcontractors are cognizant of and comply with the contractual and regulatory requirements applicable to on-site activities (e.g., Department of Transportation [DOT] regulations, Resource Conservation and Recovery Act [RCRA] requirements for waste management). When necessary, the RI Lead will document any deviations from the plans and procedures in FCRs and submit them to the PM.

- The Field Team Lead (FTL) is John Loeffel. The FTL will report to the RI Lead and will be supported by field technical staff who will perform the RI activities. The FTL will be responsible for:

  - Overseeing the day-to-day implementation of the RI activities from their onset to completion. RI activities include vegetation clearance, utility clearance, surveying, boring and well installation, sample collection and field testing, sample management, and hydrogeologic testing.
  - Implementing the Work Plan and SAP in order to ensure that the acquired data meet the data quality objectives. When necessary, the FTL will document any deviations from the plans and procedures in FCRs and submit them to the RI Lead.

- The Sample Management Coordinator (SMC) will have overall responsibility for the following:

  - Contact Jennifer Feranda/EPA RSCC or her designee with information on laboratory requirements on Tuesday the week prior a scheduled sampling event;

  - Track number of samples collected in order to collect the correct number of QC samples including MS/MSDs, sample duplicates, trip blanks and equipment rinsate blanks per case or sampling event;

  - Contact Heather Bauer, the SMO, nightly with information on samples shipped that day;

  - Contact Heather Bauer/SMO by 3 PM on Friday if samples are shipped for Saturday Delivery; Note on FedEx forms and place Saturday Delivery Stickers on coolers; Inform FedEx of Saturday delivery requirements when the coolers are dropped off at FedEx.

  - Coordinate and assist with EPA (Jennifer Feranda, Heather Bauer, etc.) any sample management related issues.

  - Prepare Sample Trip Report (Case Summaries) in Word Perfect format for each case number and submit to Jennifer Feranda (electronic copy via email and paper copy via regular mail) within 3 weeks of sampling.

- Submit "Region" copies of each Chain of Custody (COCs) to Heather Bauer within 3 weeks of sampling.
- Review data packages as they are received; Sign and date "RECORD OF COMMUNICATION" form that accompanies each data package and submit to Janet Trotter.
- Update the sample tracking table.

- The project chemist will support the procurement and management of the subcontracted laboratories on an as needed-basis, and will provide technical guidance, as requested, during the RI activities. He will also perform the review of the data quality after all the validated analytical results are received.
- Field technical staff will be assigned to the project on an as needed-basis to perform the RI activities as directed by the FTL and/or the RI Lead.

Subcontractor services will be procured for the activities listed below. Procurement of all services will involve the preparation of technical specifications describing the scope, technical requirements, and expertise needed for the performance of the needed services. The appropriate Standard Operating Procedures (SOPs) prepared specifically for this project (see Attachment B) will be included as part of the technical specifications. Immediately after the subcontractor for a service is identified, the subcontractor will be included in the project's contact list (Exhibit A-2 in Attachment A - Site Management Plan). The Project Manager, with the assistance of the RI Lead, will be responsible for communicating progress to the EPA on each of the procured subcontracts.

The activities identified as requiring subcontractor services include:

- Vegetation clearance: At the project onset, the Project Manager, RI Lead, and Field Team Lead will visit the site during the wetlands delineation and ecological risk assessment field work. The objective of this visit will be to select sampling locations and traverses for vegetation clearance. Vegetation clearance will involve a one-time cutting of the Phragmites along several lines transecting the site. We have assumed that clearing the vegetation along the following transects will be sufficient to conduct the planned investigation activities: three east to west transects, six north to south transects, and an area around existing well MW-3 where floating product is currently present. It is assumed that each transect will be approximately 30 feet wide and that the Phragmites will be removed from the site to control tick exposure during field work. During a second site visit after the vegetation clearance is completed, the PM, RI Lead, and Field Team Lead will finalize the selected sampling locations considering the limits of wetlands areas and areas of potential ecological concerns identified at the site.
- Surveying: Surveying will be performed in two mobilizations. The first mobilization, conducted before the start of the field investigation activities and after vegetation clearance, will include preparing a comprehensive, scaled site plan, surveying the locations and vertical elevations of the five existing on-site monitoring wells, surveying the centerlines of the transects where the vegetation was cleared, and surveying the boundary of the demarcated wetland areas. The second mobilization will survey the horizontal coordinates of all new sampling locations and

the vertical elevations of the newly installed monitoring wells and piezometers. This information will be plotted on the scaled site plan. If geographical positioning system (GPS) coordinates are obtained for the sampling points from the 1999 site inspection, these will also be plotted on the scaled site plan. If coordinates are not available, the locations will be estimated in relation to each other and plotted on the scaled site plan. The complete site plan will be imported into the project Remedial Investigation Data Management System (RIDMS) and used to prepare plots displaying the analytical sampling results.

- Utility clearance: This subcontractor will be responsible for utility clearance. This will be performed in addition to utility clearance through the New Jersey One Call System. Utility clearance will be performed using one or more of the following methods depending on the encountered field conditions: Ground Penetrating Radar (GPR), Electromagnetics (EM), Magnetic Methods (MAG).

- Drilling and well installation: This subcontractor will complete the boring and well installation program. The subcontractor will be responsible for obtaining the necessary drilling permits and for supplying all services (including labor, equipment, and materials) required to perform all borehole drilling and well construction. The subcontractor will be responsible for following the decontamination procedures specified in this SAP. Upon completion of the work, the subcontractor will be responsible for demobilizing all equipment, cleaning any materials staged on-site during the drilling operations, and properly abandoning all borings not completed as monitoring wells. The drilling subcontractor will also be responsible for performing the downhole logging of the boreholes for the four deep monitoring wells using a Natural Gamma logging tool.

- Analytical laboratory: The selected laboratory(ies) will be responsible for performing all analyses not available through the CLP program including the analyses of samples of free product. The analytical laboratory(ies) will be responsible for performing the analyses in accordance with the specified analytical methods and associated quality control procedures.

- Waste disposal: This subcontractor will be responsible for removing all solid and liquid wastes from the site and for their transport and disposal in accordance with all applicable regulatory requirements. The PM, in coordination with EPA, will be responsible for determining the classification of the wastes generated by the RI activities and for obtaining EPA approval of the selected disposal facilities.

Additional subcontractor services / purchase orders will be issued for the supply of all field facilities and services. Since these activities are not related to on-site sampling, they are not discussed further in the document.

Section 3.0 QUALITY ASSURANCE PROJECT OBJECTIVES

3.1 DATA QUALITY OBJECTIVES PROCESS

Data quality objectives (DQOs) are qualitative and quantitative statements, which specify the quality of the data required to support the decisions on the need for and type of remedial activities. DQOs can be defined as what the end user expects to obtain from the remedial investigation results, and are developed through a seven-step process:

Step 1 State the problem
Step 2 Identify the decision
Step 3 Identify inputs to the decision
Step 4 Define the study boundaries
Step 5 Develop a decision rule
Step 6 Specify limits on decision errors
Step 7 Optimize the decision for obtaining data

The DQOs for the Diamond Head Oil site RI/FS were developed based upon EPA 600/R-96/055 Guidance for the Data Quality Objectives Process EPA QA/G-4 (April 2000). The considerations that went into developing the DQOs under each step of the DQO development process are described below.

Step 1: State the Problem

The Diamond Head Oil site is a former oil reprocessing facility, which was in operation from 1946 to early 1979. During facility operations, multiple aboveground storage tanks (ASTs) and possibly in-ground pits were used to store oily wastes. These wastes were intermittently discharged directly to adjacent properties to the east and the wetland area on the south side of the site, creating an oil lake. The following three areas of operations, which may act as continuing sources of site contamination and the outlines of which are currently still visible at the site, developed over the years of site operation:

- A landfill – with an approximate area of 7 acres
- The oil reprocessing section of the site – with 2 buildings, multiple ASTs, drum storage areas, and possibly in-ground pits, and
- An oil lagoon – with an approximate area of 5 acres located over the south section of the site and extending outside the site boundaries to the east and south.

During the process of constructing I-280, the entire oil lagoon was apparently excavated and filled, although there is no information on the oil and sludge removal from the lagoon and whether the excavation was completed to the native soils prior to filling or whether a sludge layer was left at the bottom of the lagoon.

From the close of operations in 1979 until 1982, the abandoned site was not completely fenced. During this time, it was reported that dumping of oily wastes and other debris took place at the site.

Although existing data indicate a potential contamination problem at the site, these data are not sufficient to determine the extent of the existing on-site contamination. Section 1 of this SAP and the RI/FS Work Plan describe the site setting and potential source areas and the data collected to date at the site. In addition, two visits to the site were also conducted to examine the lay of the land and visually assess site conditions and the locations of potential source areas.

Step 2: Identify the Decision

The information gathered during the site visits, together with the historical information on past site operations and the available analytical data, were used to establish the broad objectives of the Diamond Head Oil site RI/FS:

1. Obtain data on the nature and extent of soil, groundwater, surface water, and sediment contamination associated with the site
2. Assess the associated human health and ecological risks, and
3. Evaluate appropriate remedial alternatives.

To meet these overall objectives, the Diamond Head Oil site RI/FS will be performed in two phases. A Phase 1 remedial investigation will be performed to obtain information on contamination in areas of the site where there is currently no information; to delineate the extent of the light non-aqueous phase liquid (LNAPL) that is currently found in monitoring well MW-3 in the former lagoon area; and to investigate groundwater conditions at the upgradient and downgradient boundaries of the landfill and at the upgradient and downgradient boundaries of the site. The results of the Phase 1 investigation will then be used to determine whether a Phase 2 investigation is needed and to develop its appropriate scope. For example, during Phase 2, it may be appropriate to divide the site into two operable units: one for further investigation and delineation of on-site contamination and the second for investigation of off-site groundwater contamination.

The specific objectives for the Phase 1 investigation are outlined below. Because the objectives of the Phase 2 investigation will depend on the Phase 1 results, the Phase 2 objectives listed below are preliminary and will be modified based on the results of the Phase 1 investigation.

The established broad as well as specific Phase 1 and Phase 2 objectives will be accomplished by collecting the minimum amount of information necessary to support decisions regarding the risks associated with the site and the remedial alternatives appropriate to remedy those risks while leaving minimal data gaps. In addition, since the data obtained by EPA during the 1991 and 1999 site inspections were generated through EPA's CLP, these data will be used to complement the scope of the Phase 1 investigation activities. Together, the 1991, 1999, and Phase 1 RI data are designed to meet the Phase 1 RI objectives.

The specific objectives that need to be fulfilled from each Phase of the investigation are as follows:

<u>Objectives of the Phase 1 Investigation</u>

- Delineate the on-site extent of the LNAPL and associated soil contamination in the former lagoon area and characterize the LNAPL material.

- Investigate soil contamination (surface and subsurface, above and below the peat/native organic soil layer) in areas where data are not available from previous investigations.

- Investigate soil contamination (surface and subsurface, above and below the peat/native organic soil layer) along the boundaries of the landfill.

- Investigate groundwater contamination along the upgradient and downgradient boundaries of the site and along the upgradient and downgradient boundaries of the landfill. Groundwater quality will be investigated above and below the peat/native organic soil layer.

- Investigate surface water and sediment contamination in areas of the site where data are not available from previous investigations and immediately downgradient from the site.

Preliminary Objectives of the Phase 2 Investigation

- On-site Investigation – Supplement the Phase 1 results and collect additional information - only where needed – to meet the established Phase 2 objectives. Specific objectives may include delineating the extent of contamination identified during Phase 1, investigating conditions within the landfill boundaries, investigating groundwater hydrogeologic conditions, and investigating further groundwater conditions beneath the peat/native organic soil layer.

- Off-site investigation - Delineate the extent of any groundwater contamination plume identified to originate from the site based on the Phase 1 results.

Step 3: Identify the Inputs to the Decision

Current information about the site consists of historical information on facility operations and existing analytical data obtained during the two site inspections conducted by EPA. Although the existing data may be used as an indication of a potential contamination problem at the site and to complement the additional data to be collected as part of this RI, these data cannot be used to fully define the extent of contamination in the various media at the site. Therefore, these data cannot be used to fully support any determinations or decisions regarding the risks posed by the site and the need for remedial action. Rather, the Phase 1 RI will obtain additional information on site contamination, which together with the previous data can be used to determine whether additional investigation (i.e., a Phase 2 RI) is needed in order to meet the overall RI/FS objectives for the site. The specific Phase 1 sampling activities which were developed to complement the data collected to date at the site and fulfill the Phase 1 objectives are found in Section 4. Together, the results from the two site inspections, this Phase 1 investigation, and any subsequent Phase 2 investigation will be used to define the public health and ecological risks posed by the identified site contamination and the remedial alternatives needed to address these risks.

Step 4: Define the Boundaries of the Study

The Diamond Head Oil site occupies approximately 15 acres in Kearny, Hudson County, New Jersey. The potential contamination source areas identified based on the existing historical information, are located mostly on-site – the oil processing section of the former facility, the landfill, and the majority of the footprint of the former lagoon. A portion of the lagoon's footprint is located off-site and there is no information on the off-site impacts of the site. Therefore, the Phase 1 RI will investigate contamination in the various media at the site. Based on the Phase 1 RI results, a determination will be made regarding the need to extend the investigation activities to off-site areas during the Phase 2 RI.

The goal of the Diamond Head Oil site RI is to obtain the data necessary to support the selection of a remedial approach within 18 months after the start of the Phase 1 investigation activities.

Step 5: Develop a Decision Rule

The Diamond Head Oil site RI (Phase 1 and 2) data, together with the data from EPA's site inspections, can be used to fully characterize and delineate the extent of contamination at the site as well as evaluate the site's effects on off-site groundwater quality. As action levels for the various media to be investigated have not yet been set for the project, analytical methods are planned that will provide the lowest level of detection available through EPA's CLP. The results from the CLP analyses will be used to evaluate the human health risks and appropriate remedial action alternatives. Some analyses will need to be performed by subcontracted laboratories outside of CLP. All these analyses will be performed using standard EPA methods. The detection levels for these analyses will be those achievable by the specified method. The results from these analyses will be used to evaluate remedial action alternatives.

Step 6: Specify Limits on Decision Errors

An evaluation of the true state of the environment is not feasibly obtainable, and only an estimate can be achieved through sample collection and analysis. The probability of sampling and measurement errors that exists at any site under investigation, necessitates the use of standard sampling and analytical protocols and the collection of quality control samples. The sampling locations and frequency for the Diamond Head Oil site RI were selected to minimize the error in assessing the state of the environment while QC samples will be collected to monitor both the precision and accuracy of the sampling team and the precision and accuracy of the analytical methods. Field errors will also be minimized by requiring that the field team follow standard operating procedures (SOPs) for all on-site activities. These SOPs are provided in Attachment B to this plan.

The acceptable limits on the probability of making a decision error are dependent on the consequences of the error. The data collected from the Diamond Head Oil site RI will be used to determine whether any human health risks and ecological risks are associated with the site and the remedial approach necessary to remedy any unacceptable risks. Therefore, the acceptable limits for the error allowed in making a decision are quite low. Consistent with that, sampling and analytical methods were selected for the RI that will provide accurate and sufficient data for characterizing site contamination resulting in a low probability of error in data interpretation and decision making. Section 3 describes the QA/QC objectives set for the data in order to support the decision making process for the site.

Step 7: Optimize the Design

The investigation approach used for the Diamond Head Oil site RI is designed to optimize the use of available resources. Specifically, the scope of the Phase 1 investigation activities was developed to meet the established Phase 1 RI objectives while making use of the previous data collected by EPA, since these data were determined to be of usable quality. In addition, the Phase 1 data collection efforts will focus on potential areas identified at the site. The planned investigation activities avoid any unnecessary sample collection and will collect the right amount of data needed to meet the Phase 1 RI objectives and support a determination of whether a Phase 2 investigation is needed in order to meet the overall RI/FS objectives.

3.2 DATA QUALITY CATEGORIES

DQOs are composed of written expectations for precision, accuracy, representativeness, comparability, and completeness (PARCC) of a data set. These aspects will be further defined in the next subsection. The DQO process provides a logical basis for linking the QA/QC procedures to the intended use of the data, primarily through the decision-maker's acceptable limits on decision error.

The data generated during the Diamond Head Oil site Phase 1 RI will consist of two types of data: screening data and definitive data.

Screening data are generated by rapid, less precise methods of analysis with a percent of the screening data typically being confirmed with definitive data. Screening data will be collected as part of the sampling program as well as for health and safety monitoring. The portable instruments that will be used to collect the screening data are described below. Since the screening data will not be used to characterize site contamination but to select the times and locations for collecting environmental samples and to monitor the health and safety of the work environment, laboratory confirmation of the screening data are not planned.

<u>Screening instruments and associated data to be collected as part of the sampling program</u>

- Multi-probe water quality meter for measurements of the following: temperature, pH, oxidation reduction potential (ORP), specific conductance, dissolved oxygen, and turbidity to determine when conditions are appropriate for collecting samples for definitive analyses at off-site laboratories.
- Photoionization detector (PID) used to screen soil samples for VOCs in order to select the samples to be sent for laboratory analysis.
- Water level indicator for water level measurements to be used in determining groundwater flow direction.
- Product thickness indicator for product thickness measurements to identify the presence and extent of floating LNAPL. A sample of the LNAPL will be collected for characterization analyses by and off-site subcontracted laboratory .
- Shakė test performed on soil samples to identify the presence of LNAPL trapped in soil pores.
- In-situ pressure transducers to collect continuous information on groundwater level fluctuations and tidal influences at the site.

<u>Screening instruments to be utilized for health and safety monitoring</u>

- Photoionization detector
- Draeger tubes
- Combustible gas/oxygen/hydrogen sulfide monitor
- Miniature Real-time Aerosol Monitor

Definitive data are generated using rigorous analytical methods and guidelines and satisfy established QA/QC requirements. Analytical data provided by off-site laboratories will be designated as definitive data. QA/QC elements of definitive data include determination and documentation of equipment calibrations, detection limits, method blanks, method control samples, and matrix spike recoveries.

Definitive data to be collected as part of the sampling program:

- Engineering parameters for soil and groundwater – the results will be used to evaluate remedial alternatives.
- Chemical composition and physical characteristics of free product found floating on the groundwater table.
- Target Compound List (TCL) and Target Analyte List (TAL) parameters in soil, groundwater, surface water, and sediment – the results will be used to characterize contamination, assess the human health and ecological risks, and evaluate appropriate remedial alternatives.
- Waste characteristics of investigation derived wastes for the purpose of characterizing the wastes for disposal.

3.3 QA/QC CHARACTERISTICS

The overall QA/QC objective for the field investigation is to provide data of known and documented quality through the use of established procedures. The quality of the data is determined by the evaluation of the precision, accuracy, representativeness, completeness, and comparability of the analytical results. Data quality objectives for each of these parameters are established at the beginning of the RI activities based on the acceptable limits of decision error for the project as stated in Step 6 of the DQO process. Descriptions of these characteristics are provided below, and the specific objectives for both the screening and definitive data to be generated during the Diamond Head Oil site RI are presented in Exhibit 6. Further information on the field investigation procedures and analytical methodologies are presented in Sections 4.0 and 6.0, respectively.

3.3.1 Precision

Precision is the measure of agreement in repeated tests or analyses of the same sample. Precision can be expressed in terms of standard deviation (SD), relative standard deviation (RSD) and/or relative percent difference (RPD). The precision of environmental samples has two components - laboratory precision and sampling precision.

Laboratory precision is determined by replicate measurements of laboratory duplicates and by analysis of reference materials. To assess error associated with analyte interference with the quantitation of other analytes and error due to laboratory bias and precision, laboratory control samples and laboratory control sample duplicates are analyzed by the laboratory for the parameters of interest. The Relative Percent Difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed. The equation for this calculation is presented below.

$$RPD = \frac{|MSR - MSDR|}{(MSR + MSDR)/2} \times 100$$

where: MSR = Matrix Spike Recovery
MSDR = Matrix Spike Duplicate Recovery
| | indicates absolute value of the difference.

Laboratory control samples will be analyzed by the laboratory at a frequency of 1 per 20 samples. The QC criteria shall be those specified in Exhibit 6 of this plan.

The precision of the field sampling effort is determined by the analysis of field sample duplicates. Field sample duplicates will be collected at a rate of 10 percent (i.e., one duplicate for every 10 samples) or a minimum of one per week. The acceptance criteria for aqueous duplicate samples will be a RPD of 20%. Soil duplicate sample results will be acceptable at a RPD of 30% due to the heterogeneous nature of soil.

3.3.2 Accuracy

Analytical accuracy will be assessed through the analysis of quality control samples specified in the analytical method (i.e., matrix spike, surrogate spike). The quality control samples will be used to reduce the sources of error associated with sample matrix, sample preparation, and analysis techniques. Accuracy is defined as a measure of how close an analytically determined concentration is to the true value. The analytical accuracy will be expressed as the percent recovery (%R) of an analyte which has been added to the environmental sample at a known concentration before analysis and is calculated according to the following equation.

$$\%R = [(A-B)/C] \times 100$$

where: A = The analyte concentration determined experimentally from the spiked sample.
B = The unspiked sample concentration.
C = The amount of spike added.

The laboratory must meet or be better than the control limit objectives, specified in the applicable analytical methodologies.

To assess sample accuracy, field quality control samples will be collected including matrix spike and matrix spike duplicate pairs (MS/MSD), trip blanks (TB), and field blanks (FB). The matrix spike/matrix spike duplicate samples will be used to assess the matrix interference, if any, that may influence the analytical results. Matrix spike/matrix spike duplicates will be collected at a frequency of 1 per 20 samples or a minimum of one per week. The blanks will be used to evaluate errors arising from potential cross-contamination due to: improper handling of samples by collectors and lab personnel, improper decontamination procedures, improper shipment and storage, or on-site atmospheric contaminants. One trip blank will be included in every cooler containing aqueous samples for VOCs analysis. A field blank will be collected at the frequency of one blank per decontamination event per type of sampling equipment, not to exceed one per day. Based on the field quality control samples, data qualifiers will be assigned to the results. Accuracy criteria can be found in Exhibit 6 of this SAP.

3.3.3 Representativeness

Representativeness is the degree to which the results of the analyses accurately and precisely represent a characteristic of a population, a process condition, or an environmental condition. In this case, representativeness is the degree to which the data reflects the contaminants of concern present and their concentration magnitudes in the sampled site areas. Therefore, representativeness is a qualitative parameter, which is most concerned with the proper design of the sampling program and proper laboratory protocol. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples is collected. Therefore, data representativeness will be ensured through the following processes:

- Careful selection of sampling locations
- Following the sampling procedures in the SAP developed for the project (Field SOPs)
- Following the quality control procedures in the SAP
- Using standard analytical procedures and following all method requirements (e.g., preservation, holding times, bottle requirements, etc.)

3.3.4 Completeness

Completeness is defined as the percentage of samples that meet or exceed all the objective levels for accuracy, precision and detection limits within a defined time period or event. It is the measure of the number of data points, which are judged to be valid, usable results. The objective for completeness for this field investigation is 90 percent, and will be calculated by dividing the number of usable data results (i.e., those results not considered to be rejected or those samples not able to be analyzed) by the number of possible data results (i.e., the total number of field samples collected), and then multiplying by 100 to generate a percentage.

3.3.5 Comparability

Comparability is the degree of confidence with which results from two or more data sets, or two or more laboratories, may be compared. To achieve comparability, standard environmental methodologies will be employed in the field and in the laboratory.

3.4 IMPACT OF FAILURE TO MEET DATA QUALITY OBJECTIVES

The QA objectives presented in Exhibit 6 represent the data quality necessary to achieve the project's technical goals. The QA/QC efforts discussed in this SAP focus on assessing measurement error, and ultimately providing a database that can be used to determine the quality of the collected data. Project performance will be continuously evaluated during the field investigation to determine whether the achieved results meet the stated objectives. Nonconformance to this SAP or deficiencies that could affect the precision or accuracy of the reported results will be identified and noted. If the stated objectives are not being met, corrective actions will be taken to achieve the precision and accuracy requirements of this SAP as stated in Section 11.0. In the event that the precision and accuracy QA criteria cannot be achieved after corrective measures have been taken, the precision and/or accuracy criteria may be modified to incorporate field/measurement conditions.

4.0 REMEDIAL INVESTIGATION ACTIVITIES

4.1 OVERVIEW OF RI ACTIVITIES

This section provides an overview of the field investigation and sampling operations by matrix and type of procedures. The field investigation will consist of the following landmark tasks:

- Delineation of wetlands and selection of final sampling locations and traverses for vegetation clearance
- Vegetation clearance
- Two-phase site survey (property and site plan survey including existing monitoring wells AND sampling location and elevation survey)
- Repair of the existing property perimeter fence by adding an additional side gate
- Geophysical survey for utility clearance
- Mobilization and demobilization of field facilities and equipment
- Surface water and sediment sampling
- Boring installation and subsurface soil sampling with LNAPL shake and Sudan IV tests
- Downhole gamma tool geophysical logging
- Piezometer installation and monitoring for LNAPL thickness
- Monitoring well installation and development
- Groundwater sampling and water level measurements
- Tidal influence investigation
- Decontamination

The Site Management Plan in Attachment A details how the RI activities will be managed (e.g., site access and security, temporary facilities, management of RI-derived wastes, etc.).

The sampling program described in this section will be conducted in accordance with established Standard Operating Procedures (SOPs). These are provided in Attachment B. Attachment C contains the Heath and Safety Plan, which will be followed during the RI activities. The data collected during this investigation will be managed in accordance with the Data Management Plan in Attachment D.

4.2 DETAILED DESCRIPTION OF RI ACTIVITIES

4.2.1 Mobilization and Demobilization

The purpose of the mobilization is to familiarize field team members with the site setting and the planned field investigation activities and to assemble the required equipment and support facilities at the site. The mobilization effort will consist of activities such as logistical planning, identification and staking of sampling locations, equipment and field facilities mobilization to the site, and field personnel orientation and training. The orientation and training will familiarize the field personnel with the history of the site, the health and safety plan requirements, and the field investigation procedures. In addition, all field personnel will be responsible for familiarizing themselves with the

Diamond Head Oil Site RI/FS Work Plan and this SAP, including all attachments. Personnel will be asked to sign a statement that they are familiar with these documents before the start of the RI activities.

Equipment and facilities mobilization will entail the collection, ordering, purchasing, fabricating, transporting, and setting at the site of all sampling materials, equipment, supplies, facilities, and services needed to implement the field investigation. The following on-site facilities and services will be provided:

- Installation of fence gate
- Vegetation clearance
- Field sanitary facility
- Field office and storage trailers
- Drinking water cooler
- Trash dumpster and trash removal services
- Storage tank for RI-derived waste water
- Storage tank for clean water
- Monthly water delivery
- Electrical connection (and monthly fee)
- Phone connection (and monthly fee)
- Computer rental
- Ice chest with periodic supply of ice for use in sample packaging
- Field sampling equipment (consumables and rental)
- Decontamination pad for heavy equipment (e.g., drill rig)

The set-up of these facilities is described in the Site Management Plan in Attachment A. All field facilities, except for the decontamination pad, will be rented and their set-up at the site supervised by CH2M HILL staff. The driller will be responsible for setting-up the decontamination pad under CH2M HILL's supervision.

The purpose of the demobilization at the completion of the field activities is to remove field facilities, sampling equipment and supplies, and personnel from the site. Demobilization will also include containerizing, staging and inventory of investigation-derived wastes, which will remain on-site until properly disposed of; decontamination and demobilization of field equipment; demobilization of supplies, and organization of investigation records.

No analytical data will be collected during the mobilization/demobilization task.

4.2.2 Site Reconnaissance

The site reconnaissance activities are comprised of the first round of non-invasive site observations and qualitative site characterization, and the initial logistical activities that are required to prepare the site for full mobilization and subsequent intrusive investigation activities. The reconnaissance activities include a delineation of wetland boundaries, collection of ecological risk assessment data, selection of RI sampling locations, vegetation clearance, the first phase of the site survey, and geophysical clearance of subsurface utilities and other obstructions at the selected sampling locations.

4.2.2.1 Ecological Risk Assessment Data Collection, Wetland Delineation, and Selection of RI Sampling Locations

In addition to reviewing available literature and interviewing knowledgeable government and organizational specialists, a site-specific ecological risk assessment will be performed which includes delineation of classified wetlands.

A site visit is planned at the start of the site investigation activities to collect ecological risk assessment data, delineate wetlands, and select vegetation clearance paths and preliminary soil boring, piezometer, monitoring well, surface water and sediment sampling locations. The wetlands delineation, ecological risk assessment, and field investigation teams will work closely during this initial site visit to ensure that the objectives of the Phase 1 investigation are met while the impacts of the investigation activities on site wetland areas and ecological resources are minimized. This will be achieved by selecting vegetation clearance paths and sampling locations, where possible, outside of the limits of the on-site wetlands areas. The entire 15-acre site will be reviewed for the presence of wetlands.

The wetland delineation will involve placing sequentially numbered flags along the jurisdictional boundaries of each identified wetland and water body. The flagging will be left on-site so that field teams can orient themselves easily during field activities. A minimum of four soil points will be documented for vegetation, hydrology, and soils and flagged accordingly (e.g., SP-1 through SP-4). The location of all wetland flags and soil points will be surveyed during the Phase 1 survey activities. A site plan showing the delineated wetland areas will be prepared and will present the wetland boundaries and areas of wetland impacts. Photographic documentation and field survey sheets will be completed for each wetland and water body within the site. In addition, US Army Corps of Engineers (USACE) data sheets will be completed for the study area.

During a second site visit after the vegetation clearance is completed, the PM, RI Lead, and Field Team Lead will finalize the selected sampling locations.

No laboratory analytical data will be collected during these activities.

4.2.2.2 Vegetation Clearance

This subtask will begin with the site visit described above when the PM, RI Lead, and FTL will demarcate the lines where site vegetation will need to be cleared and will select preliminary sampling locations.

A subcontractor will be procured to clear the vegetation, which will involve a one-time cutting of Phragmites and underbrush along several lines transecting the site. Vegetation will be cleared along three east to west transects, six north to south transects, and an area around well MW-3. Each transect will be approximately 30 feet wide, and the cut vegetation will be removed from the site in order to reduce tick exposure during field work.

4.2.2.3 Site Survey

A subcontractor will perform the surveying services in two mobilizations.

The first mobilization, taking place before the start of the field investigation activities, will include preparing a site plan. The site plan will be prepared in Microstation Bentley format and include the property line, remnant building and tank farm foundations, landfill boundaries, delineated wetland boundaries (including all flag points), notable site features and the locations and elevations of the five existing monitoring wells. In addition to preparing the site plan, the surveyor will provide the latitude and longitude of three points on the property as well as the latitude and longitude of the existing wells in decimal degrees to an accuracy of 6 decimal places. These data points will be used to import the site plan into the GIS component of the project's Remedial Investigation Data Management System (RIDMS) (see Attachment D Data Management Plan) for use in data visualization.

The vertical elevations of the existing wells will be surveyed during the first mobilization to an accuracy of 0.01 foot referenced to the National Geodetic Vertical Datum 1929 from the nearest datum benchmark (USGS monument). Corrections to the NAD 1988 datum will also be provided for each elevation. The following three elevation points will be established for each well:

- The top of the inner well casing (PVC well riser)
- The top of the protective outer casing
- The ground surface on the north side of each monitoring well location

The second mobilization for the surveying subcontractor will include surveying the horizontal locations of all on-site and off-site Phase I sampling locations and the vertical elevations of the newly installed monitoring wells and piezometers. The surveyor will provide latitude and longitude and vertical elevation information to the accuracy specified above.

No analytical data will be collected during the surveying task.

4.2.2.4 Geophysical Subsurface Utility Clearance

The objective of this task is to use surface, non-invasive geophysical methods, to identify underground utilities or other obstructions to drilling at the selected boring locations. These methods will be employed in addition to the utility mark-outs which will be made by the New Jersey One Call System to indicate utility lines to the property boundary.

No analytical data will be collected during the geophysical survey task.

Utility clearance will be performed by a subcontractor in a single mobilization. Each location will be scanned for underground utilities. If the location cannot be scanned directly because of physical conditions (e.g., flooded) or because of interference (e.g., nearby metallic objects), the area surrounding the sample location will be scanned for the presence of utilities that lead to the sample location.

To ensure the detection of the widest possible range of subsurface utilities and structures, one or more of the geophysical methods and instruments listed below will be used. The actual instruments or methods used will depend on the encountered field conditions and results. All instruments will be used in accordance with the manufacturer's instructions.

Ground penetrating radar (GPR) – A GPR will be used to scan sampling locations or the areas around and leading to these locations for subsurface nonmetallic or metallic utilities/structures. GPR systems produce cross sectional images of subsurface features and layers by continuously emitting pulses of radar frequency energy from a scanning antenna as it is towed along a survey profile. The radar pulses are reflected by interfaces between materials with differing dielectric properties. The reflections return to the antenna and are printed on a strip chart recorder or displayed on a video monitor as a continuous cross section in real time. Since the electrical properties of metal are distinctly different from soil and backfill materials, metallic pipes and other structures produce dramatic and characteristic reflections. Fiberglass, plastic, concrete, and terra cotta pipes and structures also produce recognizable, but less dramatic reflections.

Electromagnetics (EM) – The survey areas will also be scanned with an EM instrument such as the Fisher TW -6 pipe and cable locator and tracer. In pipe and cable search mode, the TW-6 is essentially a deep-sensing metal detector which detects any electrically conductive material. As the instrument is swept along the ground surface, subsurface metallic bodies distort the electromagnetic field created by the transmitting coil. The change in field strength is sensed by the receiver, setting off an audible alarm and/or causing deflection of an analog meter. The TW-6 can nominally detect a 2-inch metal pipe to a depth of 8 feet and a 10-inch metal pipe to a depth of 14 feet. In pipe and cable tracing mode, the TW-6 transmitter can be coupled directly (conductively) to exposed portions of a metallic pipe, cable, or wire or inductively to a subsurface metallic utility with known location and orientation. The transmitter remains stationary and energizes the utility, which can then be traced at the ground surface using the mobile TW-6 receiver. Depths to metallic structures or utilities can be determined (to within approximately 0.5 feet) using inductive or conductive mode triangulation.

Another instrument that may be used is the Radiodetection CAT& Genny system operating in a fashion similar to the TW -6 in pipe tracing mode but with a different signal frequency. The CAT & Genny also has the capability of tracing an active sonde or mole inserted into an accessible pipe (1.5 inch diameter or greater) on flexible push rods. The sonde is nominally detectable to a depth of 16 feet, and is therefore particularly useful for tracing deep and/or non-metallic sewer lines.

In areas that may have limited GPR depth penetration (e.g. due to site-specific soil conditions or the presence of metallic reinforcing), a Geonics EM-61 instrument may be employed to locate metallic structures. The EM-61 uses a one meter square coil to transmit 150 electromagnetic pulses per second into the ground at closely spaced (e.g. 3 inches) measurement stations. A second transmitter coil is used to narrowly focus the pulses, making the instrument insensitive to overhead and/or nearby sources of electromagnetic interference such as buildings, fences, power lines, surficial debris, and atmospheric electromagnetic activity. During the off-time between transmitted pulses, a receiver coil measures the decay of transient electrical currents induced by the transmit pulses. Electrical currents in moderately conductive earth materials (e.g. damp clays, mineralized or oxidized soils, etc.) dissipate rapidly, leaving the more prolonged currents resulting from buried metallic objects to be detected. The EM-61 detects and measures the prolonged transient currents, providing a digital read-out of the metallic content of the subsurface at depths up to approximately 12 feet. Note that the EM-61 focusing coil can be used to minimize the response from surficial metallic debris, which would mask the presence of deeper metal from standard EM, metal detector, or GPR instruments. For structures or utilities detected with the EM-61, the target depth can be estimated using the standard signal-width-at -half -amplitude relationship.

Magnetic methods (MAG) - The sampling locations may also be scanned with a Fisher FX-3 MAG instrument which contains two elements that measure the difference in total strength of the earth's magnetic field between two fixed heights above the ground surface (i.e. the magnetic gradient). In the absence of artificial magnetic fields or buried ferromagnetic objects, the natural gradient of the earth's field is relatively constant. Where buried magnetic or ferromagnetic objects (e.g. magnetite or iron/steel respectively) are present, the gradient varies rapidly as the instrument is swept along the ground surface, triggering an audible alarm. The MAG instrument that may be employed for this survey would nominally detect a 2-inch steel pipe to a depth of 4 feet.

4.2.3 Soil Boring Installation, Testing of Soil for LNAPL, Subsurface Soil Sampling During Boring Installation, and Downhole Geophysical Logging

The Phase 1 RI will obtain information on the nature and extent of the subsurface soil contamination that may be related to the potential source areas identified at the site. This will be accomplished by installing and sampling a total of 39 (35 shallow and 4 deep) soil borings. Preliminary locations are shown in Exhibit 3. The final locations will be selected during the initial and follow-up site visits described under the site reconnaissance task. The complete scope of the soil investigation program is described in Exhibit 5.

The 35 shallow soil borings will investigate the shallow subsurface soils and fill materials to the top of the organic material/peat layer estimated to occur at approximately 20 feet below the ground surface (bgs) at the site.

The shallow soil boring program will be implemented as follows:

- 13 soil borings with soil sampling will be completed and abandoned upon completing the sampling.
- 12 soil borings with soil sampling will be completed as piezometers.
- 10 soil borings will be completed as permanent shallow wells (6 of these will include soil sampling; the remaining 4 will be completed as monitoring wells without soil sampling since soil sampling will be performed in the four deep borings, which will form couplets with these 4 shallow wells).

The 4 deep soil borings will investigate the shallow subsurface soils and fill materials, the organic material/peat layer, and the native soils immediately below this peat layer to a depth of approximately 50 feet bgs. The focus of the deep borings is the evaluation of soil (and groundwater) conditions below the peat layer.

The deep soil boring program will be implemented as follows:

- 4 borings with soil sampling will be completed as permanent double cased deep monitoring wells.
- In addition to observations of lithology from soil core samples, the 4 deep borings will be logged using a downhole natural gamma geophysical tool.

Downhole geophysical logging will be performed through the steel drill casing to the terminal depth of the boring using a Natural Gamma tool. The drilling subcontractor will perform the logging following the manufacturer's instructions for the logging equipment used.

Note that four of the shallow monitoring wells will be installed in conjunction with the four deep monitoring wells to form four well pairs. At the locations of the four well pairs, soil samples are planned to be collected only from the boring being installed for the purpose of constructing the deep monitoring well unless field observations indicate the need to collect soil samples also in the boring being installed for the purpose of constructing the shallow monitoring well (e.g., staining is observed or there is other indication of contamination).

The sequence of performing the boring program will be as follows:

- Install the 12 borings around monitoring well MW-3 and complete them as piezometers
- Install the 19 shallow soil borings, 6 of which will be completed as monitoring wells
- Install the eight borings (4 shallow and 4 deep) which will be completed as well pairs

All soil borings will be installed using the RotaSonic drilling technology. This technology utilizes a rotary core barrel in conjunction with resonating vibrations tuned to optimal frequencies for drilling through the given strata (i.e., the drill stem vibrates and rotates, cutting through the formation). The technology uses larger diameter core barrels/drill stems (e.g., 6, 10, or 12-inch) to keep the borehole open, and smaller diameter (e.g., 4-inch) core barrels to retrieve continuous, 10-foot length soil cores in plastic sleeves. The length and diameter of these soil cores offer the following advantages over other drilling technologies:

- Provides sufficient soil volume to collect the soil samples for CLP analyses as well as the soil samples for the field "Shake/Sudan IV Tests".
- Allow continuous observations for the presence of LNAPL over the entire length of the soil core, which is longer than the length available through other drilling technologies.
- Allow for the soil core to be "opened" in order to observe for LNAPL on a fresh interior core sample, where smearing has not affected the soil.
- Provide continuous lithologic information over core lengths, which are longer than the lengths available through other drilling technologies.

The RotaSonic core sleeves will be visually observed as they are brought to the surface and scanned with a PID. The PID results will provide indication on whether VOCs are present in the soil and thus, aid in the selection of the exact intervals from which the samples for laboratory analyses are to be collected. The soil interval with the greatest indication of potential contamination (e.g., PID readings, visual staining) will be sampled for laboratory analysis. In the absence of field screening indications of contamination, soil samples will be collected from the pre-determined intervals described below.

Three soil samples will be collected from each <u>shallow soil boring</u>. The samples will be collected at the following depths bgs: 0" – 6" (shallow sub-surface soil), the approximate middle of the boring (fill material), and the bottom of the boring (fill material immediately above the peat layer).

Six soil samples will be collected from each <u>deep soil boring</u>. The samples will be collected at the following depths bgs: 0" – 6" (shallow sub-surface soil), the approximate middle of the fill material above the peat layer, the bottom of the fill material immediately above the peat layer, 12" – 18" into the peat layer, the bottom of the peat layer, 12" – 18" below the peat layer within the native soil.

Note that the depth intervals sampled at each boring location may very depending on the depths of the peat layer and native soil.

Within each interval selected for sampling, the section from which the samples will be collected, will be selected based on the following criteria, listed in order of importance:

- Results of PID measurements (soils with high PID readings will be sampled)
- Visible staining or discoloration
- Middle section of the selected interval or professional judgment if the PID or observations do

not indicate the presence of any VOCs

For each soil sample, a maximum interval of 2 feet of core material will be used (i.e., samples will not be composites of larger core intervals). Within the 2 feet, the sample for VOC analysis will be collected first using En Core® Samplers followed by the sample for the Shake/Sudan 1V Tests (see description below of LNAPL investigation). Once the samples for VOC analysis and the Shake/Sudan IV Tests are collected, the remaining soil from the selected sample interval will be placed in a stainless steel mixing bowl and will be thoroughly homogenized by turning and mixing the entire soil volume three times using a stainless steel spoon. Following the last turning, soil will be placed into additional soil sample jars for analyses for other organic compounds and metals. Additional sample jars will be filled for the QC samples. Thus, the samples collected for laboratory VOC analyses are considered discrete samples while the samples collected for the remaining laboratory analyzes are considered composite samples. The soil sampling procedures are described in detail in the SOPs in Attachment B.

Once the completion depth of a boring has been reached, piezometers and monitoring wells will be constructed in several pre-designated borings. The remaining borings will be backfilled in accordance with NJDEP boring abandonment guidelines described in the appropriate SOP in Attachment B.

All soil samples from the Phase I RI will be analyzed for TCL VOCs, TCL semi-VOCs, TCL pesticides/PCBs and TAL metals. The samples will be analyzed through EPA's CLP.

Additionally, soil samples will be collected from each of the three geologic horizons (fill material, peat, native soil below the peat) at one deep boring location (along the east border of the existing landfill) and analyzed for the geotechnical engineering parameters listed in Exhibit 8. The samples for formation porosity will be collected from the center of the 4-inch diameter RotaSonic soil core by immersing the sample jar directly into an exposed section of the core.

An LNAPL investigation program will be performed as part of the subsurface soil investigation. The LNAPL investigation consists of installing a minimum of 12 soil borings around monitoring well MW-3 for the following observations for the presence of LNAPL:

1. Visual observations of soil cores for evidence of staining or LNAPL trapped in the soil pores.
2. Collecting soil samples to undergo a Shake Test and Sudan IV Dye Test for the determination of LNAPL trapped in the soil pores.
3. Installation of temporary piezometers in the borings for measurement of free-phase LNAPL on the water table.

The 12 soil borings will be installed by moving radially outward from monitoring well MW-3 at a minimum of 15 feet spacings. If there is evidence of free-phase LNAPL on the groundwater table in the most outward borings, additional borings will be installed following the same pattern until free-phase LNAPL is no longer observed. The objective of this part of the LNAPL investigation is to delineate the extent of any free-phase LNAPL around well MW-3. The decision to expand the LNAPL investigation around this well will be made after consultation with the EPA Project Manager.

In addition, if free-phase LNAPL is observed on top of the groundwater in any of the other soil borings installed at the site during this Phase 1 RI, the EPA Project Manager will be contacted for direction on whether a similar LNAPL investigation should will be implemented around these borings.

A minimum of three soil samples will be collected from each of the 12 borings for the performance of a Shake Test and Sudan IV Test. The samples will be collected from the same depths from which the samples for laboratory analyses are collected and will be collected immediately following the collection of the soil sample for VOC analysis (prior to homogenization of the remaining soil for the remaining analyses). See description above on determining the depth intervals where samples for laboratory analyses are to be collected. If field observations indicate the presence of LNAPL at other depths, additional samples will be collected for the performance of the Shake Test. The decision to collect additional samples will be made by the FTL.

In addition, if there is LNAPL staining suggesting the potential presence of LNAPL trapped in the soil pores at any of the other soil boring locations, samples for the performance of the Shake/Sudan IV Tests will be collected at these locations. The decision to collect these additional samples will be made by the FTL.

The Shake Test is a quantitative field screening test to evaluate the presence of free-phase LNAPL trapped in the soil pores. The test - described in detail in the Shake Test SOP presented in Attachment B - consists of combining a known volume of soil with a known volume of water in a clear glass jar. A hydrophobic dye (Sudan IV) is added, which colors any LNAPL (separated as free-phase following the shaking of the sample or remaining adsorbed to the soil particles) in red. The jar is vigorously shaken and then allowed to stand and settle for 30 minutes. Following the settling period, the jar is examined for LNAPL floating on the water surface. The thickness of any observed LNAPL is measured and recorded for correlation to PID readings from the soil core and LNAPL thickness measurements in corresponding piezometers. In addition, coloration within the soil matrix is recorded to serve as indication on whether any LNAPL still remains adsorbed to the soil particles. The Shake/Sudan IV Tests are subjective tests, so steps will be taken to ensure that the same field team member performs all of the tests in order to manage testing and observation errors.

The depths where soil samples will be collected in each boring, the planned CLP analyses, and the corresponding bottling and preservation requirements are provided in Exhibit 7. The same information for the soil samples to be analyzed outside of the CLP (i.e., analyses for geotechnical parameters to be used in the engineering evaluation of remedial alternatives) is provided in Exhibit 8. The field quality control samples that will be collected, how to collect them, and their required frequencies are described in detail in Section 8.0.

At the completion of investigation activities at each boring location, the location will be marked with a flagged- or spray painted-wooden stake so that it can be surveyed and incorporated onto the scaled site plan. A subcontracted surveyor will survey the horizontal locations of all borings, including vertical elevations for monitoring wells and piezometers,

The following SOPs provided in Attachment B will be used to perform the soil investigation:

Standard Operating Procedures for Subsurface Soil Investigation	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures

4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
10	Boring Installation Methods and Soil Sampling: RotaSonic Drilling
11	Borehole Abandonment
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
15	Low Stress (Low Flow) Groundwater Purging and Sampling
16	Subsurface Soil Sampling
17	Collection and Preservation of Soil Samples for VOC
18	LNAPL Shake Test
22	Natural Gamma Borehole Logging

The field screening of the soil cores and the results of the Shake Test performed on soil samples will generate screening type data. The soil samples analyzed for TCL organics, TAL metals and for the geotechnical parameters will generate definitive type data.

4.2.4 Monitoring Well and Piezometer Installation and Development

Monitoring wells will be installed at 10 of the shallow soil boring locations, and at the four deep soil boring locations. Exhibit 3 shows the approximate locations of the proposed monitoring wells at the site. Piezometers will also be completed at the 12 shallow soil boring locations installed radially around existing monitoring well MW-3.

The 10 shallow wells (maximum terminal depth of 20 feet bgs) and the four deep wells (estimated depth of 50 feet) will be constructed using nominal 4-inch schedule 40 PVC casings, with 20-slot (0.020 inch) screen. The screen length for the shallow wells will be 20-feet, enabling the well to be screened across the water table and to the top of the peat. This 20-foot screen length will allow observations of LNAPL floating on top of the water table as well DNAPL – if any is noted – on top of the surface of the peat layer.

The four deep monitor wells, which will be installed below the peat layer, will be constructed as double cased wells with permanent isolation casing through the overburden materials and into the peat layer. Details for the construction and sequencing of the permanent isolation casing installation are provided in the Monitoring Well and Piezometer Design and Construction SOP presented in Attachment B.

The screen length for the deep monitoring wells will be either 10- or 20-feet, and will be determined in the field for each well based on observations of the geologic cores obtained during the drilling of the well boring. Specifically, if low transmissivity materials are observed in the core at the depth at which the deep well screen is planned, the well will be constructed using a 20-foot screen length. If higher transmissivity materials are observed at that depth, then a 10-foot screen length will be used. While some indication as to the appropriate screen length will be available at the first deep well location, the actual screen length at each location will be determined based on the specific lithologic information obtained at that location.

All wells and piezometers will be constructed in accordance with NJDEP guidelines, and completed with a stick-up steel protective casing and concrete pad construction. Each well and piezometer will also be furnished with a water-tight cap and lock.

The twelve piezometers (maximum terminal depth of 20 feet) will be constructed in a similar fashion as the monitoring wells, but with the following modifications: 1) nominal 2-inch schedule 40 PVC screens and casings will be used; 2) twenty foot long, 20-slot (0.020-inch) screen with coarse gravel pack will be installed to promote migration of LNAPL into the piezometer.

The piezometers will be installed radially from MW-3, where the presence of LNAPL was observed, and will be used to determine LNAPL thickness. At this time, groundwater samples for laboratory analyses are not planned to be collected from the piezometers.

Each of the 14 newly installed monitoring wells (10 shallow and 4 deep) and the 12 piezometers will be developed to clear the screen following construction activities and to promote groundwater (and LNAPL) flow into the well. The 5 existing monitoring wells will also be re-developed to stimulate the stagnant wells, evaluate the condition and usability of the well, and promote groundwater flow. Development will be performed using a combination of surge blocking and pumping to purge the well.

The wells and piezometers will be developed by pumping the groundwater with an electric-powered submersible pump. The submersible pump intake will be placed below the water level and lowered as the water level drops. The well will also be surged with an appropriately sized surge block over the entire length of the screen to facilitate the removal of fine sediments at the bottom of the monitoring well. Polyethylene tubing, connected to the pump with stainless-steel clamps, will be used. New tubing will be used for each well and will be disposed of after use. Water will not be added to any well to aid in development, nor will any type of airlift technique be used.

Measurements of water quality parameters will be recorded every five minutes during monitoring well development. The water quality parameters will include pH, temperature, conductivity, and turbidity. Development water will be containerized in a portable polyethylene tank and transported to the on-site storage tank.

Well development will begin no sooner than 48 hours, but no later than seven days, after the cement surface completions are in place. Development will proceed until one of the following conditions are met as long as the sediment thickness remaining in the well is less than 5 percent of the screen length:

- Stabilization of water quality parameters defined as less than 10 percent variance between the removal of two successive well volumes, with a target of less than 10 NTU turbidity units.

- Five well volumes purged, regardless of stabilization of the water quality parameters.

The water quality field parameters measured during well and piezometer development will generate screening type data.

The following SOPs provided in Attachment B will be used to install and develop the wells:

Standard Operating Procedures for Well & Piezometer Installation and Development	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
4	Field Parameter Forms
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination
10	Boring Installation Methods and Soil Sampling: RotaSonic Drilling
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
16	Subsurface Soil Sampling
17	Collection and Preservation of Soil Samples for VOC
18	LNAPL Shake Test
22	Natural Gamma Borehole Logging

The horizontal locations and vertical elevations of all existing and new monitoring wells and piezometers will be surveyed by a surveying subcontractor during a second mobilization to the site at the end of the Phase 1 RI activities.

4.2.5 Groundwater Sampling and LNAPL Sampling

The purpose of the groundwater sampling is to obtain information on the horizontal and vertical extent of groundwater contamination associated with the site. Therefore, groundwater samples will be collected from a total of 19 monitoring wells:

- The 5 existing monitoring wells
- The 6 newly-installed shallow monitoring wells
- The 4 newly-installed well clusters (4 shallow wells & 4 deep wells)

Between them, these wells monitor the full saturated thickness of the fill materials occurring above the organic material/peat layer, and a section of the vertical sequence below the peat layer. The wells are situated along the upgradient and downgradient boundaries of the site, as well as immediately upgradient and downgradient of the on-site landfill. Additionally, a subset of the wells are potentially located upgradient, downgradient, sidegradient and within the area known to contain LNAPL around existing well MW-3. Exhibit 3 shows the proposed monitoring well locations at the site.

After a minimum of two weeks following the development of the monitoring wells, groundwater samples will be collected using the EPA's low-flow sampling method. Low-flow sampling minimizes disturbance and drawdown of the water column and resultant cascading of formation water into the well. A discrete interval of the well screen, located at the point of the pump intake, is purged at low flow velocities (200 – 500 ml/minute) so that formation water is drawn into the well from only that interval, and the remaining water column in the well is undisturbed. VOC concentrations in samples collected after low-flow purging have been shown to be much more representative of true formation conditions. Additional benefits to low-flow purging include minimization of suspended sediment in samples, generally more rapid stabilization of water quality parameters, and significant reduction in the quantity of purge water that has to be containerized and hauled off-site for treatment and disposal.

To collect the groundwater samples, an electrically powered submersible pump (e.g., Grundfos 2-inch RediFlo pump) will be lowered to the middle of the screened interval. The pump intake will be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment at the bottom of the well. Dedicated teflon-lined polyethylene discharge tubing will be used for all sampling. All discharge water from the sampling activities will be collected and transported to the on-site storage tank.

During well purging, the discharge water from the pump will be monitored for pH, temperature, turbidity, ORP, DO, and specific conductance. The results of this monitoring will be recorded at a frequency of at least once per 5 minutes. Pumping will continue until these parameters stabilize. The parameters will be considered to have stabilized when the difference between three successive readings is less than: 10% for turbidity and DO, 0.1 standard unit for pH, 3% for conductivity, and 10 mV for ORP.

Once the indicator parameters stabilize, the groundwater sample will be collected directly from the discharge tubing by filling the appropriate sample bottles pre-preserved for the required analyses.

The groundwater samples collected from the new and existing wells will be analyzed by EPA's CLP laboratories for TCL VOCs, semi-VOCs, pesticides and PCBs, and TAL total metals. In addition, groundwater from the shallow and deep well pair located immediately downgradient of the landfill will be sampled for dissolved metals through CLP and for the natural attenuation groundwater quality parameters listed in Exhibit 8. The results will be used in the engineering evaluation of remedial alternatives.

At the time of the groundwater sampling event, one sample will be collected from the LNAPL observed in well MW-3. The sample will be collected with a disposable bailer and sent for the following analyses by a subcontracted laboratory: TCL organics and TAL metals, Gasoline- and diesel-range organics (GRO and DRO), full TCLP analysis, hazardous waste characteristics (ignitability, corrosivity, and reactivity), and specific gravity.

The bottling and preservation requirement for the TCL and TAL analyses through CLP are provided in Exhibit 7. The same information for the groundwater and LNPAL samples to be analyzed outside of CLP is provided in Exhibit 8. The field quality control samples that will be collected, how to collect them, and their required frequencies are described in detail in Section 8.0.

The field testing of groundwater quality parameters performed during purging of the wells will generate screening type data for the following parameters: pH, temperature, turbidity, ORP, DO, and specific conductance. The groundwater and LNAPL samples analyzed by off-site laboratories will generate definitive type data.

The following SOPs provided in Attachment B will be used during groundwater sampling:

Standard Operating Procedures for Groundwater Sampling	
SOP Number	**SOP Topic**
1	Sample Nomenclature

Standard Operating Procedures for Groundwater Sampling	
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
15	Low Stress (Low Flow) Groundwater Purging and Sampling

4.2.6 Tidal Investigation, Water Level Measurements, and LNAPL Thickness Measurements

In addition to groundwater sampling, a tidal influence investigation, water level measurements (for groundwater contouring), and LNAPL thickness measurements will be collected as part of the hydrogeologic investigation.

A tidal investigation will be performed in the four well pairs (4 shallow wells and 4 deep wells) to evaluate the effects of tidal cycles on site hydrogeology. The evaluation will be performed by installing pressure transducers in each of the wells and allowing them to continuously record water level fluctuations over a one week period. At the completion of the data collection period, the transducers will be retrieved from the wells and the pressure data (i.e., water level data) will be reviewed. If practicable, based on the field investigation schedule, the tidal influence study will be performed during the period of a full moon, during which time the lunar affect will be greatest on the tidal cycles.

Two rounds of synoptic water level and product thickness measurements will be collected, one at the beginning of the tidal investigation and one at the beginning of the groundwater sampling event. Measurements will be collected from each of the 19 monitoring wells and 12 piezometers (31 locations within the 15 acre site) using an electronic water level/product interface probe. The water level data will be used to generate groundwater piezometric maps for the determination of hydraulic gradients and groundwater flow directions at the site, and the product thickness measurements will be utilized to evaluate the extent and thickness of the LNAPL plume and its effects on groundwater quality at the site.

No samples will be collected for laboratory analysis during these investigation activities. All of the data collected during the tidal investigation, water level measurements, and LNAPL thickness measurements will be screening type data.

The following SOPs provided in Attachment B will be used to collect the measurements:

Standard Operating Procedures for Water Level, LNAPL Thickness, and Tidal Measurements	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
4	Field Parameter Forms

Standard Operating Procedures for Water Level, LNAPL Thickness, and Tidal Measurements	
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
9	Equipment Decontamination
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
19	Monitoring for Tidal Influences

4.2.7 Surface Water and Sediment Sampling

In support of the ecological evaluation and overall characterization of contamination at the site, 10 surface water and 10 sediment samples will be collected. The sampling locations for surface water and sediment will be selected by the ecological investigation and wetland delineation teams during the site visit at the onset of the Phase 1 investigation activities. At least one sample will be collected downstream of the site at the confluence of the drainage ditch bordering the Diamond Head property and Frank's Creek.

The surface water and sediment samples will be collected by hand. Before surface water samples are collected, one set of field water quality parameters will be collected, including pH, temperature, turbidity, ORP, DO, and specific conductance.

The surface water and sediment samples will be analyzed by EPA's CLP laboratories for TCL VOCs, semi-VOCs, pesticides and PCBs, and TAL metals. The bottling and preservation requirement for the TCL and TAL analyses are provided in Exhibit 7. The field quality control samples that will be collected, how to collect them, and their required frequencies are described in detail in Section 8.0.

The field testing for surface water quality parameters performed during the collection of the surface water samples will generate screening type data and the surface water and sediment samples analyzed for TCL organics and TAL metals will generate definitive type data.

The following SOPs provided in Attachment B will be used during surface water and sediment sampling:

Standard Operating Procedures for Surface Water and Sediment Sampling	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements.
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination
17	Collection and Preservation of Soil Samples for VOC
20	Surface Water Sampling
21	Sediment Sampling

4.2.8 Potable Tank Water, Fire Hydrant Water, and Type I Deionized Water Quality Sampling

Four types of water will be utilized throughout the RI activities, two of which will be used for decontamination of equipment:

1) Potable water will be supplied to the site on an as-needed basis by a subcontractor. The water will be stored in a 1,000- gallon clean-water storage tank. This water will be of potable quality (i.e., meeting federal and state drinking water standards) This water is for general use (e.g., hand washing) in lieu of an on-site source of running water. This water will also be the raw supply for an on-site Type I deionized water generation system.
2) ASTM Type I deionized water will be generated on-site through the use of a multi-stage filtration system. This water will be used for the decontamination of all sampling equipment (e.g., bowls, trowels, pumps).
3) Water from a fire hydrant in the neighborhood will be used by the driller to decontaminate the drilling equipment and for drilling activities.
4) ASTM Type II deionized water (reagent grade) will be supplied by a commercial vendor. The Type II DI water will be used in the generation of quality assurance blank samples (e.g., trip blanks, field blanks). The type of water, manufacturer, and lot number for each batch of water delivered to the site will be recorded in the field log books. Appropriate documentation as to the purity of each lot of this water will be obtained from the vendor.

To document the quality of the water used for decontamination, the following samples will be collected at the start of the field activities and analyzed by EPA's CLP laboratories for TCL VOCs, semi-VOCs, pesticides and PCBs, and TAL metals. The results are considered to represent definitive type data:

- One sample and a duplicate will be collected from the potable water supply tank, or tank water (TW). This will document the quality of the source water for the Type I DI system.

- One sample and a duplicate will be collected from the first batch of Type I DI water produced at the site. The sample will be collected after the Type I DI water has been transferred into a bulk storage / jug container. Thereafter, one sample and a duplicate will be collected once per month.

- One sample and a duplicate will be collected of the fire hydrant water used by the driller. The sample will be collected directly from the bulk storage tank utilized by the driller (e.g., the drilling water truck).

- Because the quality of Type II Deionized water is certified in Lot batches by the vendor, no samples of this water will be collected.

The pH, temperature, turbidity, ORP, DO, and specific conductance of each water supply will be recorded immediately prior to sampling.

The samples will be collected in accordance with the following SOPs, provided in Attachment B:

Standard Operating Procedures for Water Quality Confirmation Samples	
SOP Number	**SOP Topic**

Standard Operating Procedures for Water Quality Confirmation Samples	
1	Sample Nomenclature
3	Field Logbook Procedures
4	Field Parameter Forms
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination

The on-site Type I DI water treatment system will be a water filtration ion-exchange system from Cole-Parmer laboratory supply company. The Cole Parmer system uses disposable ion-exchange filter columns (1 adsorber, 2 universal cartridges, 2 research cartridges) in series to de-ionize the water. The water will be generated as-needed and stored in dedicated polyethylene carboy jugs for bulk use during decontamination events.

4.2.9 IDW Sampling

One sample will be collected from the IDW-water 21,000 gallon storage tank and up to five samples will be collected from the drums containing IDW. The sample from the storage tank will be obtained using a disposable bailer. The samples from the drums will be obtained following the procedures for soil sampling. The water sample will be analyzed for hazardous waste characteristics and the soil samples will be analyzed for full TCLP.

The bottling and preservation requirements are provided in Exhibit 8. No field quality control samples will be collected as part of the IDW sampling since the data will not be used for risk assessment purposes. The analyses will be performed by a subcontracted laboratory and will generate definitive type data.

4.2.10 Air Monitoring

The air quality investigation conducted during the Diamond Head Oil site RI will consist of monitoring the ambient air during RI activities. Real-time air monitoring for VOCs will be conducted during tasks involving intrusive activities (e.g., drilling activities, well installation and development). The monitoring program is described in detail within the Health and Safety Plan (HASP) in Attachment C and is summarized below.

Air quality monitoring will be conducted for worker safety purposes. Real-time air quality data will be compared to exposure action levels, which if exceeded, will trigger the need for corrective action. The exposure action levels will be used to ensure that potential community exposures (at the site perimeter) to airborne contaminants are maintained at levels no greater than one order-of-magnitude less than occupational exposure limits. Because the developed action levels are based on existing site-specific contaminant data (types of contaminants, concentrations, media, exposure limits) and instrument responsiveness, these action levels are considered to be conservative. The air monitoring and associated action levels will be as follows:

Air Monitoring Specifications and Action Levels					
Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
PID: MiniRae 2000 with 10.6eV lamp or	All intrusive tasks	0-1 ppm → 1-10 ppm → >10 ppm →	Level D Level C Level B	Initially and periodically during task	Daily

equivalent					
CGI: MSA model 260 or 261 or equivalent	Drilling Excavating	0-10% LEL:→ 10-25% LEL:→ >25% LEL:→	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2 Meter: VRae or equivalent	Drilling Excavating	>25%[c] O_2: → 20.9%[c] O_2: → <19.5%[c] O_2: →	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily
Dust Monitor: MiniRam PDM-3, or equivalent	Drilling Excavating	< 1 mg/m^3 → > 1 mg/m^3 →	Continue Implement dust suppression; contact HSM to determine need for lead air monitoring	Initially and periodically during tasks	Not Applic able
Noise-Level Monitor [d]: Voice	Drilling Excavating Heavy Equipment Use	Must raise voice and shout to communicate at 3 feet→	Hearing protection required Stop; re-evaluate	Initially and periodically during task	Not Applic able

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).
[d] Noise monitoring and audiometric testing also required.

The following SOPs provided in Attachment B will be used to monitor ambient air during the RI activities:

Standard Operating Procedures for Ambient Air Monitoring	
SOP Number	**SOP Topic**
3	Field Logbook Procedures
4	Field Parameter Forms
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)

4.3 DECONTAMINATION PROCEDURES

The purpose of decontamination is to remove all foreign chemical compounds from non-disposable field sampling equipment in order to prevent the equipment from artificially introducing chemical constituents into samples during collection or other sampling activities (e.g., drilling, etc.). If any chemical compounds or inorganic constituents are introduced into a sample as a result of contact with contaminated field sampling equipment, the validity and resulting data quality is compromised. Decontamination assists in ensuring that the field samples collected and the resulting analytical data are representative of actual site conditions, and that the established DQOs are not impacted. The effectiveness of field decontamination procedures will be assessed through the collection and analysis of field blanks (a.k.a. equipment rinsate blanks) as described in Section 8.0.

Depending on the type of equipment to be decontaminated, the decontamination procedures utilize multiple stages of rinsing/washing fluids and/or pressurized steam that are known to be free of the analytes of interest. The fluids/steam will be passed through and/or over non-disposable equipment according to established procedures to remove potential contaminants and prevent cross-contamination between sampling locations. All non-disposable equipment involved in field sampling activities will be decontaminated prior to sampling. Equipment leaving the site will also be decontaminated. Attachment B contains a detailed SOP that will be used by field personnel in decontaminating equipment. This procedure is also summarized below.

All drilling equipment will be steam-cleaned with a pressure washer prior to use. Well screens and riser pipe, if not cleaned and fully encased in plastic by the manufacturer, will also be steam-cleaned to remove any cutting oils or soil from shipping. The equipment will be rested on clean polyethylene sheeting. Pressurized steam will be used to remove all visible excess material from drill steel, drill bits, the back of the drill rig, and any other parts of the rig which may contact the media under investigation. If visible contamination still exists on the equipment after the rinse, a non-phosphate detergent scrub will be added, and the equipment thoroughly rinsed again with pressurized steam. Steam cleaning will be conducted on the decontamination pad, which will be constructed on-site for the field investigation. All water will be collected and transported to the on-site storage tank.

Field instrumentation (such as interface probes, pH meters, etc.) and equipment used for hydrogeologic testing, downhole geophysical logging, and other non sampling uses will be decontaminated between sample locations by rinsing with DI water. If visible contamination still exists on the equipment after the rinse, a non-phosphate detergent scrub and rinse will be added, and the probe thoroughly rinsed again with DI water.

Decontamination of all non-disposable, non-electrical sampling equipment (including sampling bowls, trowels, shovels, beakers, etc.) will be conducted as described below:

1. Non-phosphate soap (e.g., Liquinox) and potable water scrub.
2. Potable water rinse.
3. A 10% nitric acid rinse (ultra pure grade) when sampling for inorganics, unless using carbon steel sampling equipment when a 1% nitric acid solution should be used to avoid stripping of metals.
4. DI water rinse.
5. 10 % Methanol rinse
6. Air dry.
7. DI water rinse.
8. Air dry.
9. Wrap or cover exposed portions of equipment with aluminum foil (shiny surface out) for transport and handling

For the low flow purge and sampling, the decontamination procedures will be as specified by the current version of the Region II Low Flow Standard Operating Procedures, as follows:

Non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, must be decontaminated thoroughly each day before use (daily decon) and after each well is sampled (between-well decon). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using daily decon procedures (see i. below) prior to their initial use and/or installation. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled (between-well decon).

i. Daily Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for five minutes and flush other equipment with potable water for five minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for five minutes and flush other equipment with fresh detergent solution for five minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for five minutes and flush other equipment with potable water for five minutes.

D. Disassemble pump.

E. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a stiff brush.

F. Rinse pump parts with potable water.

G. Rinse the following pump parts with distilled/deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing

H. Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I. Rinse impeller assembly with potable water.

J. Place impeller assembly in a large glass bleaker and rinse with 10% methanol.

K. Rinse impeller assembly with distilled/deionized water.

ii. Between-Well Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for five minutes and flush other equipment with potable water for five minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for five minutes and flush other equipment with fresh detergent solution for five minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for five minutes.

D. Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

The need to decontaminate sampling equipment during the Diamond Head RI will be kept to a minimum in the field by, wherever possible, utilizing disposable sampling equipment. Decontamination fluids will be stored in US Department of Transportation (DOT)-approved 55-gallon drums or in the on-site storage tank for proper disposal. Personnel involved in equipment decontamination will wear protective clothing, as stated in the Health and Safety Plan in Attachment C.

4.4 FIELD TECHNICAL GUIDELINES

Standard Operating Procedures will be used to implement all field activities. Their purpose is to provide field personnel with concise and clear procedures to follow in performing the remedial investigation activities. This will ensure consistent and quality performance by the field personnel.

The SOPs to be used during the Diamond Head Oil RI are provided in Attachment B. The list is provided below.

Standard Operating Procedures	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination
10	Boring Installation Methods and Soil Sampling: RotaSonic Drilling
11	Borehole Abandonment
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
15	Low Stress (Low Flow) Groundwater Purging and Sampling
16	Subsurface Soil Sampling
17	Collection and Preservation of Soil Samples for VOC
18	LNAPL Shake Test
19	Monitoring for Tidal Influences
20	Surface Water Sampling
21	Sediment Sampling
22	Natural Gamma Borehole Logging

5.0 SAMPLE MANAGEMENT

Following established procedures for sample management is important in maintaining data quality. Strict custody procedures are necessary to ensure the integrity of the environmental samples. The subsections below address sample identification, packaging, shipping, and documentation. Procedures followed during the field investigation will be in accordance with the EPA User's Guide to the Contract Laboratory Program (EPA, June 2001). The following SOPs included in Attachment B describe the procedures to follow in sample management.

Standard Operating Procedures for Sample Management	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping

5.1 SAMPLE IDENTIFICATION SYSTEM

The nomenclature system that will be used to identify and track the samples collected during this Phase 1 RI is described in SOP No. 1: Sample Nomenclature, presented in Attachment B of this document. This is the same nomenclature system that will be utilized to designate the samples collected by the EPA during the site inspections performed in 1991 and 1999.

5.2 SAMPLE PACKAGING AND SHIPPING

Sample custody must be strictly maintained and carefully documented each time a sample is collected, transported, received, prepared, and analyzed. Custody procedures are necessary to ensure the integrity of the samples. Sample custody is defined as (1) being in the sampler's possession; (2) being in the sampler's view, after being in the sampler's possession; (3) being locked in a secured container by the sampler, after being in the sampler's possession; and (4) being placed in a designated, secure area.

Each laboratory receiving samples from this project must comply with the laboratory custody requirements outlined in the laboratory(ies)' own quality assurance plan.

Proper sample handling, shipment, and maintenance of a COC are key components of building the documentation and support for data that can be used to make project decisions. It is important that all sample handling and sample COC requirements are performed completely, accurately, and consistently. Each environmental sample will be properly identified and individually labeled, and secured with a custody seal. Sample labels will be filled out manually in indelible ink (for analyses outside of CLP) or through the EPA's software program *Forms II Lite* (for analyses through CLP). The labels will be securely attached to the sample bottle and the bottle cap sealed with a custody seal.

After the labeling and sealing is completed, the sample bottle will be enclosed in clear re-sealable polyethylene (PE) bag (e.g., Ziploc™ bags), through which the identifying label is visible. The sealed bag will then be placed in a hard plastic cooler that has been lined with a layer of inert cushioning material, such as asbestos-free vermiculite, bubble-wrap or corn starch – based packing peanuts. Samples will be packed with sufficient wet ice bagged in re-sealable PE bags to cool the samples to 4C.

A completed Chain of Custody (COC) form, manually (for analyses outside of CLP) or through *Forms II Lite* (for analyses through CLP) will be included with all sample shipments. The COC forms will be generated using the *Forms II Lite* software for EPA CLP organic and inorganic analyses. The COC forms for the analyses outside of the CLP will be provided by the subcontract laboratory.

The COC forms will be checked against the sample labels and field documentation by field personnel before being secured to the inside lid of the cooler. Custody seals will be placed on opposite corners of the cooler and covered with clear plastic tape. The cooler will then be secured with strapping tape (without obscuring the custody seals). A completed overnight delivery service shipping label will be attached to the top of the cooler. Wide, clear tape will be used to secure the shipping label to the cooler top to prevent it from being accidentally peeled off.

Samples being shipped by an overnight delivery service are designated to arrive at the laboratory within 24 hours of sample shipment. A member of the field team will contact the Contract Laboratory Analytical Services Support (CLASS) office (for CLP analyses) or the laboratory directly (for subcontracted analyses) to notify them of the sample shipment.

5.3 SAMPLE DOCUMENTATION

5.3.1 Sample Tracking Logbook

A cumulative sample tracking log will be maintained to document the collected samples.

This log (included in the Data Management Plan) will be used to track the collection and shipment of samples to the laboratories as well as the receipt of the validated sampling results for the CLP analyses or unvalidated results for the non-CLP or subcontracted analyses. The FTL or his designee will fill out this log each day, noting the information for the samples collected that day. At the end of each week, a copy of the log will be provided to the Project Manager, who will be responsible for tracking the remaining information on the log. The information entered in the log will also be periodically transferred into an Excel spreadsheet.

5.3.2 Field Logbooks

Field activities will be recorded in a bound weatherproof site logbook with consecutively numbered pages. As each logbook is completed, the next logbook will be assigned a sequential identification number. Entries to the logbook will be filled out legibly in indelible ink. Pencil will only be used under extreme weather conditions (e.g., freezing temperature, heavy rain) that preclude the use of ink. The site logbook will be a controlled document, which will be transferred between field team members as one team member takes over field activities from another team member. Multiple log books may be utilized simultaneously if multiple field staff are overseeing concurrent activities.

Pertinent information to be recorded in field logbooks includes all information that is necessary to reconstruct the investigative/sampling operations. Such information will cover the activities being performed and noteworthy observations while they were being performed, sample collection and shipment information, visitor's names and arrival/departure times, community contacts, and other information determined by the FTL to be noteworthy. The recorded sample information will include the sample number, collection time, location, descriptions, field measurements, and other site- or sample-specific observations. Difficulties with sample recovery and field observations (e.g., staining, visible contamination, etc.) will be noted if encountered. Discussions of field difficulties/problems and deviations from the SAP (including QAPP and FSP, along with justification) will also be described, along with corresponding times. Finally, prior to start of fieldwork each day, the FTL will record in the logbook the weather conditions, time of start of the field activities, and the personnel who are on-site.

Documentation of a field activity in the logbook will be completed immediately after the activity is performed (e.g., a sample is collected). Photographs will be taken to document field activities. A log of all photographs taken will be maintained in the field logbook. Disposable cameras will be used with each camera and exposure assigned a sequential number. A log of the photographs taken will be documented on an arbitrary page of the field logbook. The log will record the following information: camera identification number, exposure number (note that for disposable cameras, the frame number will start at 27 and decrease to 1), date and time of each photograph, name of person taking the photograph, and a brief description of the activity photographed. This log will continue until all the space on the page is used at which time the log will be transferred to continue on the next available empty page in the logbook. A note will be made at the bottom of the completed page indicating the page number where the log continues. A subsequent note will be placed at the top of the page where the log continues indicating the page number from where it was transferred. Once developed, the photographic prints will be numbered in correspondence to the logbook numbers.

Log book pages will be marked with the page number and calendar date, written on the top of each page. Logbook pages will be consecutively numbered, and upon entry of data, the logbook pages will be signed and dated by the responsible site personnel at the bottom of the last page for that day's activities. Corrections to the logbooks will consist of a single strike line through the incorrect entry, the new accurate information, the initials of the corrector, and the date of the amendment. Any blank spaces/pages in the logbook will be crossed out with a single strike mark and signed.

5.3.3 Field Investigation Forms

In addition to field logbooks, field team members will use appropriate forms applicable to the field activities. The following forms will be used and are provided in the SOP on forms and other appropriate SOPs covering the activity in Attachment B:

- Sample Tracking Log
- Soil Boring Log
- Monitoring Well Completion Diagram
- Well Development Log
- Low-Flow Groundwater Sampling: Field Data Sheet
- Daily Activities Summary
- Daily Equipment Calibration Record Sheet
- Field Change Request Form

- Shake tests observation form and Shake Test samples tracking sheet
- Water level and LNAPL thickness measurements record
- Site personnel sign-in log
- Site visitors sign-in log
- Equipment tracking log
- Equipment calibration forms

5.3.4 On-site Screening Analysis Records

The following on-site screening-type analyses will be performed in accordance with the corresponding SOPs and the results recorded in the field logbook and on the appropriate field forms:

- Soil boring samples – Quantitative measurement of VOCs off-gassed from soil samples will be measured using a PID and will be recorded on the soil boring log sheet.
- Groundwater samples - temperature, pH, turbidity, specific conductivity, ORP, and DO , as specified by the sampling program, measured using a multiprobe water quality meter, will be recorded on the low-flow sampling data sheet and well development data sheet.
- Measurments of groundwater elevations and LNAPL thickness observed in wells and piezometers will be recorded in the Water Level and LNAPL Thickness Measurement Worksheet.
- Shake test – A visual observation for the presence of LNAPL trapped in soil pores will be made and any measureable thickness of product will be recorded along with pertinent sample information on the Shake Test observations form. The observations will be made after an alloqot of soil has been placed in a glass jar with water, vigorously shaken, and allowed to stand as the aqueous and LNAPL phases separate.
- Surface water samples - temperature, pH, turbidity, specific conductivity, ORP, and DO , as specified by the sampling program, measured using a multiprobe water quality meter, will be recorded in the field logbook.

All documentation generated for and associated with field screening analyses will be subject to the same level of document control as that utilized for laboratory analyses, and will be placed in the project file.

6.0 ANALYTICAL REQUIREMENTS AND PROCUREMENT OF ANALYTICAL SERVICES

Exhibits 7 identifies the analyses that will be performed through EPA's CLP and Exhibit 8 identifies the analyses that will be performed through subcontracted laboratories. Exhibit 9 summarizes the program and also provides the holding times for the various analyses.

CLP laboratories will perform all TCL and TAL analyses of soil, sediment, groundwater, and surface water samples. Standard CLP turnaround times will be requested for these analyses.

Analyses not available through CLP will be performed by subcontracted laboratories; these analyses will be performed for subsurface soil geotechnical engineering parameters, groundwater water quality geochemistry parameters, LNAPL characterization (GRO and DRO, TCL and TAL, TCLP, and hazardous waste characteristics), and IDW characterization (TCLP and hazardous waste characteristics). A plan for the procurement of subcontracted laboratory services is provided as Attachment E. Analyses performed outside of the CLP program will have a 28 calendar day turn-around-time for final data packages. The laboratory will be required to analyze these samples using the designated analytical method for each analyte and full documentation procedures.

Analytical results will be reported in the standard units for the analyses as follows:

- Feld screening of soil samples for VOC off-gassing - ppm
- CLP analyses of soil and sediment samples -ug/kg for TCL organics and mg/kg for TCL metals
- CLP analyses of groundwater and surface water samples - ug/L for both TCL organics and TAL metals
- Non-CLP analyses of soil and water samples for geotechnical parameters and water quality parameters – reported in the standard units for the matrix and analytical method specified in Exhibit 8
- Non-CLP analysis of LNAPL characteristics - ug/L for TCL organics, TAL metals, and TCLP extract and standard units for the analytical methods used for GRO and DRO and hazardous waste charateristics determination
- Non-CLP analysis of IDW – ug/L for TCLP extract and standard units for the analytical methods used for hazardous waste charateristics determinations

7.0 ANALYTICAL DATA HANDLING, VALIDATION, AND REPORTING

Standard methods and references will be used as guidelines for data handling, reduction and reporting. All data for the project will be compiled and summarized with an independent verification at each step in the process to prevent transcription/typographical errors. Any automated entry of data will also undergo verification review.

7.1 FIELD DATA

Field instrumentation data will be recorded by site personnel in field logbooks and/or field investigation forms associated with the sampling event (see Section 5). Screening data from the field analyses will undergo a data review, which will include review of instrument calibration records to assess the quality of the data. At the end of the field investigation, the field data results will be tabulated, summarized, and entered, as warranted, in the project's computerized database.

Field data will be collected from the following activities:

- Screening of soil samples for VOCs
- Field testing of groundwater and surface water samples for pH, temperature, specific conductance, turbidity, ORP and DO
- Collection of water levels and LNAPL thickness measurements
- Soil shake tests for presence of LNAPL

7.2 LABORATORY DATA

All CLP data generated by off-site CLP laboratories will be reported in standard CLP format. All non-CLP data generated by off-site subcontracted laboratories will be reported in a CLP-equivalent format containing all required elements to review the data with the objective of determining its usability. Section 13.0 of this document provides further information on the CLP and non-CLP laboratories' report submittals.

The data obtained from the CLP laboratories will undergo a systematic data validation process to provide assurance that the data is adequate for its intended use. Specifically, the data will be validated by the EPA in accordance with the EPA Organic/Inorganic National Functional Guidelines and/or the following EPA Region II Data Validation Standard Operating Procedures (SOPs):

SOP No. HW-2: Inorganic Data Validation, Rev. 11, January 1992
SOP No. HW-6: Organic Data Validation, Rev. 11, May 1996.
SOP No. HW-13: Low Concentration Water Organic Data Validation, Rev. 2, October 1996.

For non-CLP parameters for which EPA has not defined acceptance criteria, a data review will be performed based on an evaluation of method-specific quality control data and the criteria specified in Exhibit 6 and the applicable acceptance criteria stated in Section 8 of this SAP. This statement is applicable to all non-CLP analyses as listed in Exhibit 8 since a specific EPA validation SOP is currently not available for these analyses.

EPA Region II Hazardous Waste Support Section personnel in conjunction with the EPA Division of Environmental Science and Assessment (DESA) personnel will be performing the data validation for all CLP laboratory data. DESA Laboratory Branch data (if used) will be validated by the DESA Laboratory Branch. Non-CLP laboratory data will be reviewed by CH2M HILL personnel.

Hard copies and electronic deliverables of the validated results will be requested for all analyses performed through CLP. The received validated electronic results will be imported into the project's computerized database. This process will undergo verification to ensure that all data are entered correctly into the database.

Hard copies and/or electronic deliverables will be received for all samples analyzed by subcontractor laboratories. These results will be either imported directly or hand-keyed into the project's computerized database. This process will also undergo verification to ensure that all data are entered correctly into the database.

7.3 NON-DIRECT MEASUREMENTS

As some information needed to complete the RI/FS at the Diamond Head site will not be measured directly during the field investigation at the site (e.g., analytical results from prior investigations), these data will be obtained from literature files, texts, computer databases, etc. Sources or references for all data other than that derived from the current Diamond Head RI will be acknowledged in the prepared reports. An explanation of the rationale behind using the reference and a description of any concern on using the reference data (e.g., uncertainty, conflicting literature, etc.) will be made within the report.

7.4 REMEDIAL INVESTIGATION DATA MANAGEMENT SYSTEM

A computerized Remedial Investigation Data Management System (RIDMS) will be used to manage the analytical and field data collected during the Diamond Head field investigation. A description of this system and a plan for managing data, sample results tracking, data entry into the RIDMS, data tabulation, and data plotting including the responsibilities of the various personnel involved in this process, are provided in Attachment D.

8.0 QUALITY ASSURANCE/QUALITY CONTROL SAMPLE REQUIREMENTS

8.1 FIELD QUALITY CONTROL SAMPLES

The subsections below present general information and guidance on collecting field quality control samples, including definition and frequency for each type of QC sample. Field QC samples will be labeled and shipped according to the procedures outlined in Section 5.0.

8.1.1 Field Environmental Duplicate Samples

Duplicate environmental samples will be collected for all samples that will be used in the human health and ecological risk evaluations and that are analyzed through CLP. Duplicate results will be used to evaluate the precision of the sampling procedures. Duplicate samples will not be collected for the geotechnical analyses of the soil samples, the groundwater geochemical water quality samples, the LNAPL characterization samples, and the IDW characterization samples.

Duplicate samples will be collected at the rate of ten percent of the total number of samples for each specific matrix for each type of analysis (i.e., one duplicate for up to every 10 samples) or a minimum of one duplicate per case. The duplicate samples will be collected from the same location and at the same time as the native environmental samples. Preservation and analysis of duplicate samples will be identical to those for the native samples (i.e., full TCL and TAL analysis).

Duplicate soil samples, with the exception of those soil samples being analyzed for TCL VOCs, will be collected by placing the collected sample interval into a stainless steal bowl, homogenizing, and placing into separate sample containers each labeled with a unique sample identification number.

Duplicate soil samples collected for TCL VOC analysis are known as co-located soil samples. TCL VOC co-located samples will be collected at locations within the same depth interval as close as possible to one another.

Due to the heterogeneous nature of the soil samples, the acceptance criterion in assessing the sampling procedures for the soil media is $\pm$30 percent. Aqueous duplicate samples will be collected by filling the native sample container then immediately filling the duplicate sample container for the same analyte. The acceptance criterion for assessing the sampling procedures for the aqueous media is $\pm$20%.

8.1.2 Field Blanks

Field blanks (a.k.a. equipment rinsate blanks) will be collected to assess the potential for contamination of environmental samples due to the used decontamination procedures. Field blanks will be collected by pouring DI water over and/or flushing it through the decontaminated sampling equipment and collecting the rinsate.

Field blanks will be collected at the frequency of one per decontamination event per type of sampling equipment, not to exceed one per day. Preservation and analysis of field blanks will be identical to those of the associated environmental samples (i.e., full TCL and TAL analysis). Sufficient equipment will be available and field activities scheduled to minimize the need for field decontamination of equipment and the associated number of field blanks. Analytical results will be qualified and corrective actions taken if field blanks contain detectable concentrations of the target analytes.

8.1.3 Trip Blanks

A trip blank serves to detect possible cross-contamination of aqueous samples resulting from handling, storage and shipment procedures. Trip blanks consist of two 40 ml volatile organic analysis (VOA) vials filled with DI water prior to initiation of daily field activities, which accompany the day's environmental samples through collection and shipment to the laboratory. In addition, trip blanks are stored by the laboratory under the same conditions as the environmental samples.

A trip blank must accompany each cooler containing aqueous samples for VOC analysis. These samples will be preserved and analyzed for TCL VOCs identically to the associated environmental samples. All VOC samples will be consolidated in one cooler for daily shipment, if possible, to minimize the number of trip blanks required in the field program. Analytical results will be qualified and corrective action measures taken if trip blanks contain detectable concentrations of the target analytes.

8.1.4 Type II Deionized Water for Field Blanks

Certificates of analysis from the supplier of the ASTM Type II DI water used to collect environmental blank samples will be maintained in the project files. The certificates will demonstrating that each lot of DI water used is analyte free. Therefore, QC samples will not be collected to assess the quality of the ASTM Type II DI water.

8.1.5 Potable Water, Fire Hydrant Water, and Type I DI Water Blanks

One sample and a duplicate will be collected from each of the field activity water supply sources: the potable water supply tank used for general water supply, the municipal fire hydrant from which the driller will obtain water for drilling equipment decontamination and other drilling activities, and the Type I deionized water generated on-site for sampling equipment decontamination (for which the water supply will be the general use potable water supply tank). Samples will be collected directly into the sample jars from the source. The samples will provide information on possible causes of cross contamination. These samples will be preserved and analyzed for the same parameters as environmental samples (i.e., full TCL and TAL analysis).

8.1.6 Temperature Blanks

A temperature blank will be included with each sample shipments cooler. The blank will consist of an unpreserved 40-ml container filled with potable water and labeled as "EPA Cooler Temperature Indicator". Because environmental parameters are not analyzed from this blank, full CLP bottle label and custody seal procedures are not required for these containers. Subcontracted laboratories for all non-CLP analyses will be required to record the temperature of this blank immediately upon receipt of the samples.

8.2 LABORATORY QUALITY CONTROL SAMPLES

General information and guidance on laboratory QC samples are presented in the subsections below. As standard analytical methods will be used for the analyses of all samples, laboratory QC samples will be analyzed as specified in the analytical method. Laboratories will follow all QC method requirements including procedures, frequencies, criteria, and corrective actions for the samples. The analytical methods, which will be used for sample analyses, were identified in Section 6.0.

8.2.1 Method Blanks

A method blank will be analyzed with every batch of samples to ensure that contamination has not occurred during the analytical process. Method blanks consist of a portion of analyte-free water or solid that is processed through the entire analytical procedure in the same manner as the environmental sample. The acceptable criteria is that of the requested analytical method.

8.2.2 Matrix Spikes and Matrix Spike Duplicates

Matrix spike and matrix spike duplicate (MS/MSD) samples will be used to assess the precision and accuracy of the analytical methods and the matrix affects, if any, on the analytical results. In this procedure, a field sample is spiked with a known concentration of an analyte, which is then analyzed identically to the field samples. A comparison of the resulting concentration to the original sample concentration assesses the accuracy of the analytical method while also assessing any possible matrix interference on analyte recovery that may be present in the sample. Analysis of the matrix spike duplicate, with a comparison of the resulting concentration to that of the matrix spike concentration provides an assessment of analytical precision.

Additional volume for MS/MSD samples will be collected in the field at the rate of five percent of the total number of samples for each specific matrix for each type of analysis that can be spike into a media (i.e., one MS/MSD for up to 20 samples) or a minimum of one MS/MSD per week. The accuracy and precision acceptable criteria are those stated in Exhibit 6 of this SAP.

8.2.3 Surrogate Compounds

Surrogates (also known as System Monitoring Compounds) are compounds of known concentrations added to every organic analysis sample at the beginning of the sample preparation to monitor the accuracy of recovery as a result of sample preparation and analysis. Surrogate recoveries will also be used to assess potential matrix interference. The recovery values will be compared to values established in the applicable methodologies to determine the validity of the data.

8.2.4 Internal Standards

Internal standards are used to provide instrument correction for variation in instrument performance and injection volumes. Internal standards also establish relative response factors for the analytes. The acceptance criteria for internal standards will be as established in the applicable methodologies.

8.2.5 Laboratory Control Samples

A laboratory control sample (LCS) consists of an analyte-free water or solid phase sample that is spiked with target analytes at a known concentration. The LCS will be analyzed for every batch of samples (i.e., less than or equal to 20 samples) to provide information on the accuracy of the analytical methods and on the laboratory's performance. Not all parameters can be spiked into a sample media, therefore only those parameters with accuracy limits located in Exhibit 6 will be spiked, The accuracy acceptable criteria are those stated in Exhibit 6 of this SAP.

8.2.6 Laboratory Duplicate Samples

A laboratory duplicate sample must be prepared and analyzed for each batch of samples of similar matrix. These samples serve to demonstrate acceptable method precision by the laboratory. The RPD precision criteria are those stated in Exhibit 6 of this SAP.

9.0 INSTRUMENT CALIBRATION AND PREVENTIVE MAINTENANCE

9.1 INSTRUMENT CALIBRATION

All field measurement instruments will be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer.

Calibration information for field measurement instruments will be documented (See SOP on forms to use). All project personnel using measuring equipment or instruments in the field will be trained in the calibration and usage of the equipment, and will be personally responsible for ensuring that the equipment has been properly calibrated prior to its use. Information to be recorded will include at a minimum, as applicable:

- Name of device and/or instrument calibrated, including instrument serial/identification number (if known)
- Manufacturer
- Date of calibration
- Initial settings of instrument/device
- Standards used during calibration (applicable calibration standards shall be traceable to national standards using Lot numbers, manufacturer's name, expiration date, etc.)
- Adjustments made (if any)
- Calibrated reading of instrument/device
- Signature of calibration operator
- Comments (if any)

In addition, all field instruments will undergo response verification checks immediately if the user suspects or detects anomalies in the data being generated. The checks will consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying the response. If an unacceptable response is obtained (i.e., not within specifications), the data will be labeled suspect, the problem will be documented and appropriate corrective action taken. See Section 11.0 of this plan for further information on corrective action procedures.

Off-site laboratory equipment will be calibrated using certified/nationally recognized standards and according to the applicable methodologies (as described in Section 6.0). Information on and frequency for laboratory QC samples are presented in Section 8.2 and/or the specified analytical method procedures.

9.2 PREVENTIVE MAINTENANCE

Field equipment will be maintained in accordance with the manufacturer's specifications. A check of the equipment will be performed before field activities begin, and a reasonable supply of spare parts (e.g., batteries, connectors, etc.) and maintenance tools will be available at the site, to minimize equipment downtime during the field investigation. Routine maintenance and visual checks of the equipment will be conducted on a daily basis during the time of equipment calibration. Any maintenance performed on the field equipment will be documented in the field logbook, and will be undertaken only by personnel who have the appropriate skills or training in the type of maintenance required. Information to be recorded will include at a minimum, as applicable:

- Name of device repaired, including serial/identification number (if known)
- Manufacturer
- Date of maintenance
- Maintenance performed
- Signature of repair operator
- Comments (if any)

Spare parts for the field equipment will be obtained from the vendor on an as-needed basis. A local vendor is available who can supply the spare parts to the site on the day the request is made.

Laboratories are responsible for the maintenance of their analytical equipment, in accordance with manufacturer's specifications. Laboratory personnel will be responsible for ensuring that all instruments are functioning properly and within specific guidelines prior to starting any analysis. Maintenance, performed by either laboratory personnel or the manufacturer's service personnel, will be conducted according to manufacturer's recommendations and procedures.

10.0 SUPPLIES AND CONSUMABLES

Supplies and consumables necessary for the remedial investigation will be obtained through appropriate commercial markets and will meet any supply-specific requirements outlined in this document including the Health and Safety Plan. All supplies and consumables will be inspected by field personnel prior to use. Any supplies/consumables that do not meet requirements will be returned to the supplier.

Supply-specific requirements include the following:

- Sampling equipment will be manufactured from the procedural-specific material, e.g., stainless steel bowls for soil sampling.
- Sample bottle containers will meet all guidelines specified in Specification and Guidance for Obtaining Contaminant-Free Sample Containers, EPA 540/R-93/051 and OSWER Directive 9240.0-05A (EPA, 1992b).
- Preservation chemical supplies will be of analytical reagent grade or better. Certifications from the supplier will be provided and retained in the project files. Pre-preserved sample bottles will be used.
- Decontamination chemical supplies will be of ultra pure grade nitric acid and pesticide grade methanol or better. Certifications from the supplier will be provided and retained in the project files.
- Field screening instrumentation supplies will be of the procedural-specific grade (e.g., helium carrier gas will be 99.999% purity). Certifications from the supplier will be provided .
- The DI water for use in field blanks and trip blanks will be certified to be analyte free. Certifications from the supplier will be provided and retained in the project files for each lot of DI water used.

11.0 PROJECT ASSESSMENTS

11.1 PROJECT READINESS REVIEW AND PROJECT STATUS UPDATES

The Project Manager and/or RI Lead will conduct a readiness review for field activities, prior to the commencement of the investigation. Equipment and supplies will be inventoried, and field instrumentation will be checked to ensure that all are in working order. Any maintenance activities performed during the readiness review will be documented on instrument maintenance sheets or in the field logbook.

During the field activities, the RI Lead is responsible for contacting the Project Manager to provide a daily update of that day's field activities. The update will include:

- The borings/sampling completed that day
- Deviations from the planned sampling (e.g., boring locations, number of samples)
- Deviations from the procedures in the SAP
- Problems encountered and whether they were resolved
- Any assistance needed
- Subcontractor performance
- Any anticipated effects on the project schedule and budget
- Any visitors to the site or contacts/requests made by State, local, or community members

Exhibit A-1 in the Site Management Plan in Attachment A contains the information that will be provided in the daily status report. The Project Manager may use this Exhibit to record the information or keep a record in her phone conversion logbook.

On a 10-day drilling cycle- basis, the RI Lead will also provide the Project Manager with a copy of the sample log, which the Project Manager will use to track samples and a written report of the activities completed during that cycle. After review of the progress report, a copy will be forwarded to the EPA project manager. In addition, a written monthly progress report will be submitted to the EPA.

11.2 PERFORMANCE AND SYSTEMS AUDITS

EPA reserves the right to conduct internal systems and performance audits of the off-site laboratories in accordance with EPA requirements and the laboratory SOPs. CH2M HILL will not participate in any such audits.

A designated project team member will perform a documented baseline Field Audit during the first four weeks of the field effort. A field audit may also be conducted later in the field program if significant deficiencies are identified. Field audits will verify the following elements:

- The adequacy of personnel training and specified staff requirements are met.

- Copies of the Health and Safety Plan, SAP, accompanying SOPs, Work Plan, and contractors' technical specifications are on-site and accessible to the sampling teams.

- Project files are complete.
- The measurement and test equipment are of the proper type, and have been properly calibrated, and calibrations have been recorded.
- Preventative maintenance of measurement and test equipment is being conducted at the frequency set forth in the vendors' O&M Manuals.
- Information listed in the SOP for calibration is recorded in the sampling logbooks using permanent indelible ink.
- Sample collection procedures are performed as per the SAP, using the proper sampling equipment, sample containers, and preservatives, and that the samples are placed in a cooler maintained at 4±2ºC immediately after collection.
- Review the sample shipping requirements such as proper packaging procedures as per this SAP (including sealing with appropriate custody seals).
- Review chain-of-custody form requirements including information listed in the SOP.
- Review decontamination sequences to ensure sampling equipment is properly decontaminated between sample locations.
- Review the sample management system for CLP and independent samples to ensure that it is correct.
- Review detailed technical and QA procedures for adequacy and appropriateness including review of project files to ensure completeness. This will also entail ensuring that all personnel involved with the work element under review have received and understand the technical and QA procedures as defined in the project plans.

The auditor will document any deficiencies encountered during the field audit and the actions taken to correct potential problems. This documentation will be maintained in the project file. The Project Manager or her designee is responsible for addressing any identified deficiencies. If a change in previously-approved field procedures is found to be necessary based on the audit or the information generated during the RI, a written notification (Field Change Request) will be submitted to the Project Manager.

11.3 CORRECTIVE ACTIONS

11.3.1 Field Corrective Actions

If the field audit identifies any deficiencies, the Project Manager is responsible for implementing the necessary corrective actions to address these deficiencies and to ensure that the established DQOs, specifications, and SOPs are followed. In addition, if a clarification or adjustment to the SOPs is required, the Project Manager is responsible for revising SOPs and ensuring that the revised SOPs are reviewed and approved by EPA.

Corrective action will be initiated based on deficiencies or procedural non-compliance identified during the field audit or other information obtained during the RI. Corrective action can be initiated by any personnel involved with field operations.

To enhance the timeliness of any corrective action and thereby reduce the generation of unacceptable data, deficiencies or problems will be resolved at the lowest possible management or staff level. The Project Manager will determine at which level the problem can best be resolved, and will notify the appropriate member of the project team. A closed-loop corrective action system comprised of the following will be implemented:

- Defining the problem;
- Assigning responsibility for problem investigation;
- Investigation and determining the root cause of the problem;
- Assigning responsibility for problem resolution;
- Setting due dates for completion of corrective action;
- Validating completion by verifying that the resolution has corrected the problem;
- Determining whether project specific documentation will be revised; and
- If necessary, revising project-specific documentation.

To ensure the quality of the collected data, actions to correct a problem or a deficiency and restore compliance with the requirements in this SAP, will be initiated immediately after the problem is noted, even before the formal field audit report is prepared and submitted to EPA.

11.3.2 Laboratory Corrective Actions

The laboratory department supervisors review the data generated to verify that all QC samples have been run as specified in the procedure. Laboratory personnel are alerted that corrective actions may be necessary under the following conditions:

- QC data are outside the warning or acceptable windows for precision and accuracy established for laboratory samples;
- Blanks contain contaminants at concentrations above the reporting limits specified in this QAPP; and
- Deficiencies are detected by the laboratory QA director during internal or external audits, or from the results of performance evaluation samples.

Corrective actions are implemented immediately when nonconformance in QC sample results are identified by the bench analyst. Corrective action procedures are handled initially at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors and checks such parameters as instrument calibration, spike and calibration mixes, and instrument sensitivity.

The analyst immediately notifies his or her supervisor of the problem and the investigation being done. If the problem persists or cannot be identified, the matter must be referred to the laboratory supervisor and QA/QC officer for further investigation. All laboratory QC problems that will affect the final data must be discussed with the CH2M HILL chemist or CLP-laboratory liaison as part of the corrective action process. Once resolved, full documentation of the corrective action procedure must be filed with the laboratory supervisor, and the QA/QC officer must be provided with a corrective action memorandum for inclusion into the project file if data are affected.

Corrective actions may include:

- Reanalyzing suspect samples
- Recalibration with new standards
- Eliminating blank contamination
- Resampling and analyzing new samples
- Evaluating and amending sampling and analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Recalibrating analytical instruments
- Qualifying or rejecting the data

After implementation of the required corrective action measures, data deemed unacceptable may not be accepted by the SM and follow-up corrective actions may be explored. Details of laboratory corrective actions are provided in the Laboratory QAP.

11.4 FIELD CHANGE REQUESTS

During the Diamond Head Oil site remedial investigation, it may, at times, be necessary to adjust the program to accommodate encountered field conditions. When it becomes necessary to modify previously-approved field procedures, the RI Lead will notify the Project Manager and complete a Field Change Request (FCR) Form (Exhibit 10) containing the anticipated change.

Each completed FCR form will include an explanation of the issue and a proposed solution. Once completed, the FCR form will then be forwarded to the EPA Project Manager. Each FCR must be verbally approved by the necessary personnel (i.e., the EPA Project Manager and the CH2M HILL Project Manager) before implementation of the change occurs. Work on the field activities specified in the FCR will not resume until EPA grants this verbal approval of the request. The Project Manager will be responsible for controlling, tracking, implementing and distributing all FCR forms.

11.5 SURVEILLANCES

Surveillance of field activities will be conducted by the Project Manager, RI Lead, and FTL or designated qualified technical staff. Surveillance activities include reviewing and checking project records. All surveillance activities will be documented by signature and date on the project record document reviewed.

12.0 TRAINING OF PROJECT STAFF

All project personnel will have the necessary technical training and qualification to ensure that they are capable of performing the investigation activities planned at the Diamond Head Oil site. Prior to the start of these activities, all personnel assigned to the project will be provided with copies of the Diamond Head RI/FS Work Plan and this SAP (combined QAPP and FSP) including all attachments. Staff will be instructed to review these documents in detail before the start of the field activities.

In addition, prior to the start of the field activities, the Project Manager will hold a training / project kick-off meeting. The following topics will be covered during the meeting:

- RI/FS Work Plan
  RI/FS objectives
  Scope of work
  Schedule and budget
- SAP (QAPP and FSP) requirements
  Health and Safety Plan requirements
  Responsibilities of project personnel (EPA and CH2M HILL)
  DQOs
  SOPs
  QA requirements (e.g., QA samples, sample management)
  Recordkeeing (e.g., COC, field logbooks, photographs)
- Communications with the community around the site

Attendance at the project kickoff meeting will be documented in a sign-off sheet. If additional personnel are brought to support the field activities after the kickoff meeting, the Project Manager is responsible for covering with them the above requirements before they begin their scheduled field responsibilities. Training documentation will be maintained in the project files.

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

13.1 DATA RESULTS REPORTING

The CLP laboratory(ies) performing analyses on this project will submit data packages to the EPA Regional Sample Control Center (RSCC) office in the format required by the EPA Contract Laboratory Program (CLP). A hard copy and an electronic file of all validated data results will be forwarded by the RSCC to the CH2M HILL Project Manager.

Laboratory(ies) under subcontract to CH2M HILL, will be required to submit sample results in hard copy and as an electronic file directly to CH2M HILL. The format will be appropriate to the data type. Analytical results will be presented on standard forms, and include the dates the samples were received and analyzed, the analytical method used, the detection levels achieved, units, and laboratory duplicates, blanks, laboratory control samples, surrogate recoveries, internal standards, initial and continuing calibration results, and other supporting QA/QC information allowing for the recreation of the analytical process. The laboratory report will include a written case narrative, which will note any problems encountered in receipt or during analysis and the corrective actions utilized (including telephone logs, etc.).

Data collected during this investigation will be entered into a computerized database, the data entry will be verified, the data tabulated and plotted on various maps and finally, evaluated. The complete data set entered into the database will be provided as an appendix to the RI report. The validation reports submitted by the EPA will be reviewed by CH2M HILL's project chemist. If questions or concerns arise based on the review, CH2M HILL's chemist will contact the RSCC for resolution. A discussion of the QA/QC aspects of the data (i.e., a data quality evaluation – DQE) including applicable resolutions will also be included in this report.

A comprehensive Data Management Plan has been prepared and is provided as Attachment D.

13.2 QA AUDIT REPORTING

A field audit will be performed within four weeks of the start of sampling activities. The auditor performing the audit is responsible for preparing a formal report documenting the results of the audit - any identified deficiencies along with the recommended corrective actions for compliance. The Project Manager is responsible for ensuring that this audit report is completed within two weeks of audit completion. A corrective action response due date will be identified in the cover letter of the report. In order to ensure the quality of the collected data, actions to correct a problem or a deficiency and restore compliance with the requirements in this SAP, will be initiated immediately after the problem is noted, even before the formal field audit report is prepared. The audit report will be maintained in the project file. If a change in previously-approved field procedures is found to be necessary based on the audit or the information generated during the RI, a written notification (Field Change Request) will be prepared as part of the audit report. The Field Change Request will be submitted to the EPA Project Manager.

14.0 DOCUMENT RETENTION

Field parameter forms have been developed for documenting all performed field activities. The forms are included at the end of the SOPs, which they must be used to document. A complete set of the forms is also included in the SOP on field parameter forms. During the field investigation activities, field personnel must complete the appropriate forms. The forms must be filed at the end of each day in three-ring binders provided for each form in the on-site trailer. Upon completion of the field activities, the three-ring binders will be brought back to the CH2M HILL Parsippanny office and made part of the project documentation record.

The following records will be maintained as part of the documentation of the field investigation activities and made part of the final project file turned over to EPA at the end of the project:

- Final Work Plan
- Final SAP (QAPP / FSP) including all attachments
- Correspondence
- Subcontractor specifications
- Field logbooks
- Field forms (as per SAP in three-ring binders)
- Photographs
- Hard copy and electronic data packages of all CLP and non-CLP data
- Final Reports

Project files

15.0 SCHEDULE

The schedule for the Phase 1 Diamond Head RI is provided in Exhibit 11.

EXHIBITS

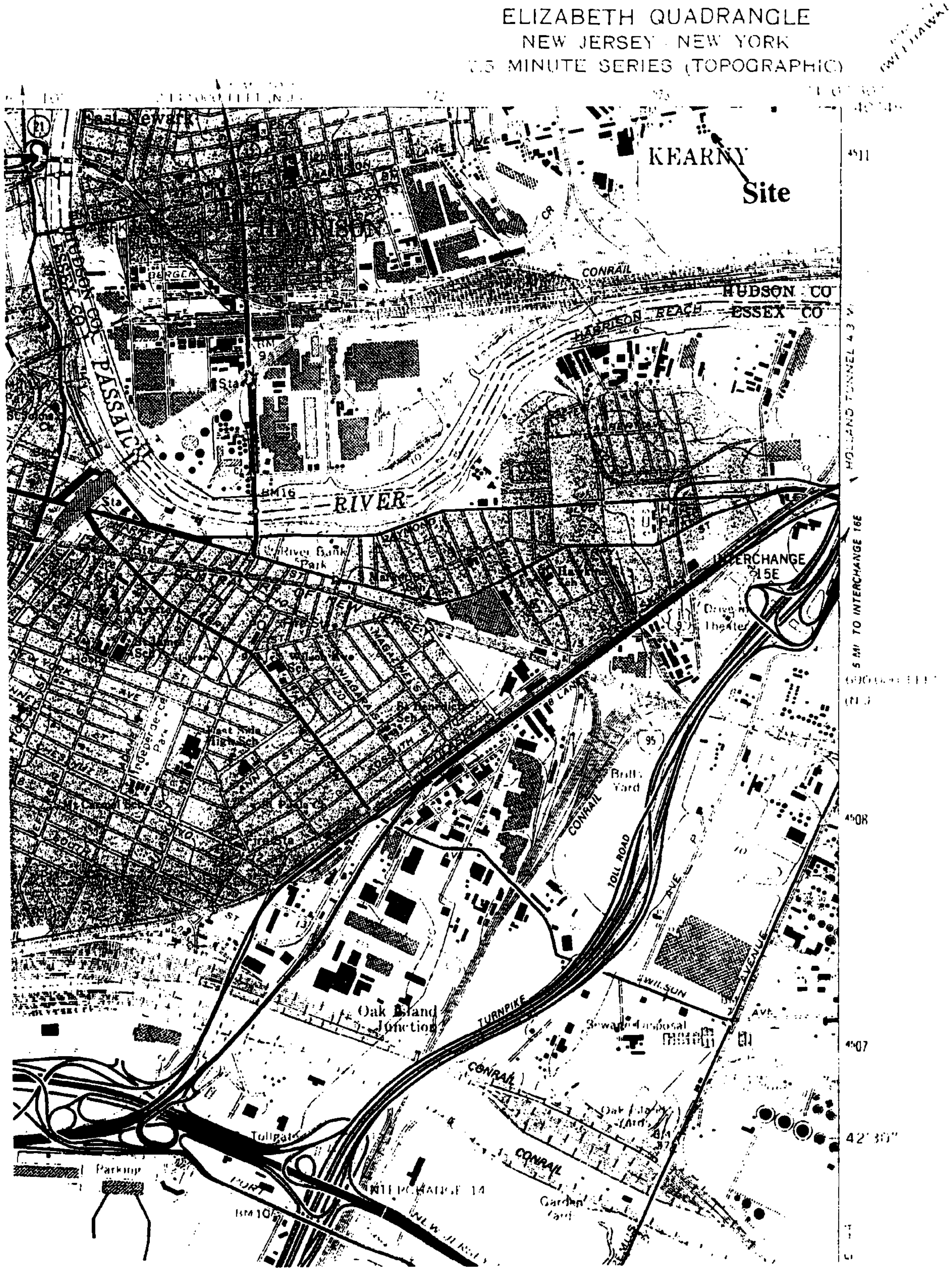
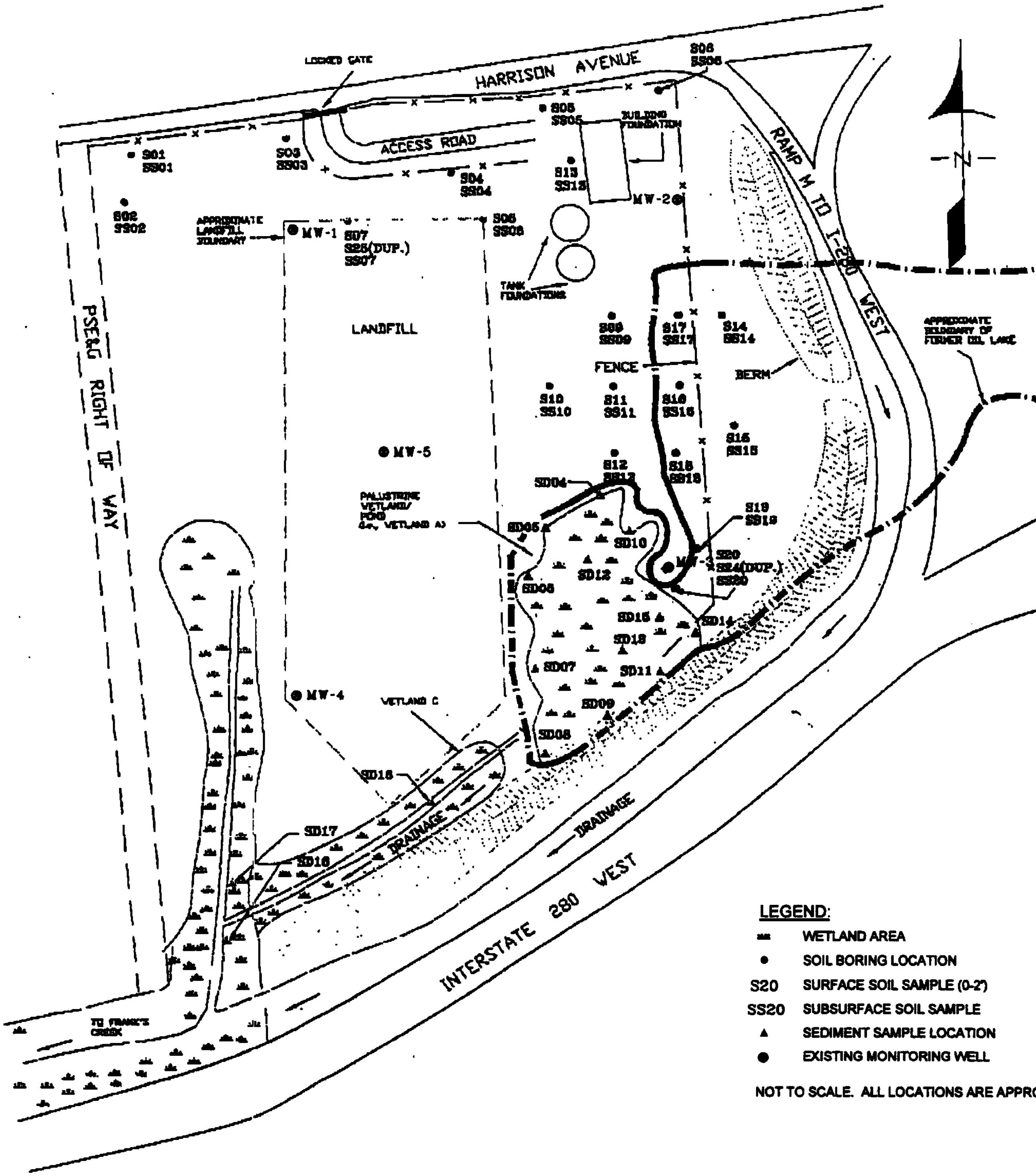


Exhibit 1
Diamond Head Oil
Site Location Map



LEGEND:

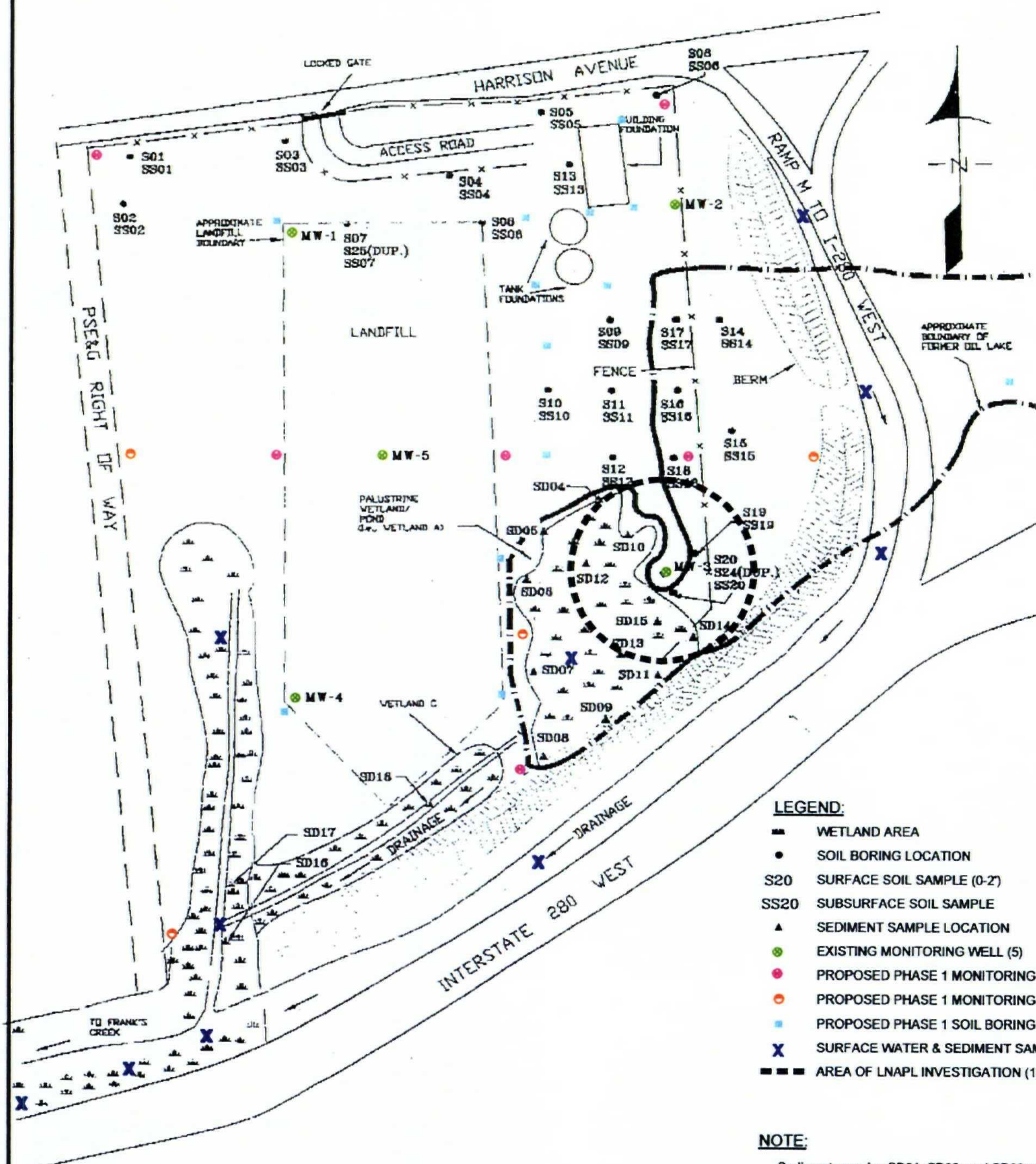
▲▲	WETLAND AREA
•	SOIL BORING LOCATION
S20	SURFACE SOIL SAMPLE (0-2')
SS20	SUBSURFACE SOIL SAMPLE
▲	SEDIMENT SAMPLE LOCATION
●	EXISTING MONITORING WELL

NOT TO SCALE. ALL LOCATIONS ARE APPROXIMATE.

Exhibit 2
SITE PLAN
Diamond Head Oil RI/FS

CH2MHILL

Source: Site plan based on plan in 1999 Roy F. Weston ESI



LEGEND:

- WETLAND AREA
- SOIL BORING LOCATION
- S20 SURFACE SOIL SAMPLE (0-2')
- SS20 SUBSURFACE SOIL SAMPLE
- SEDIMENT SAMPLE LOCATION
- EXISTING MONITORING WELL (5)
- PROPOSED PHASE 1 MONITORING WELL (6)
- PROPOSED PHASE 1 MONITORING WELL PAIR (4)
- PROPOSED PHASE 1 SOIL BORING (13)
- X SURFACE WATER & SEDIMENT SAMPLE (10 EACH)
- AREA OF LNAPL INVESTIGATION (12 PIEZOMETERS)

NOTE:

Sediment samples SD01, SD02, and SD03 were collected in 1999 off site from a wetland northeast of the site to document background wetland sediment conditions.

NOT TO SCALE. ALL LOCATIONS ARE APPROXIMATE.

Exhibit 3
PHASE 1 PROPOSED SAMPLING LOCATIONS
Diamond Head Oil RI/FS

Source: Site plan based on plan in 1999 Roy F. Weston ESI

CH2MHILL

Exhibit 4
Project Organization Structure

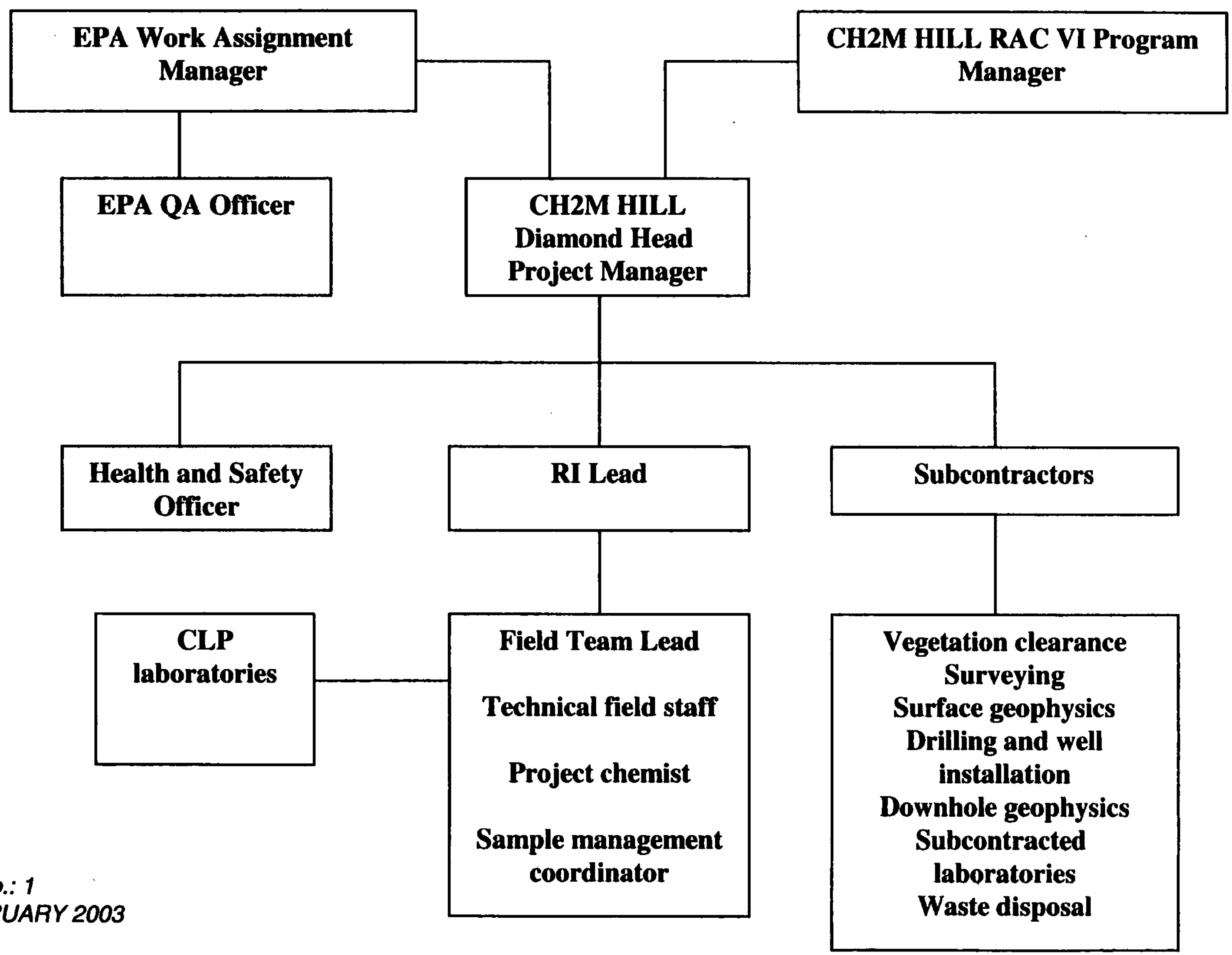


Exhibit 5
Summary of Proposed Investigation Activities for the Diamond Head Oil RI/FS
Kearny, NJ

Media	Objective of Sampling Program	Investigation Method	Selection of Sampling Locations	Drilling/ Sampling Method	Number of Investigation Locations	Depth of Investigation Method	Number of Samples per Location	Total number of samples	Sample depth	Analysis
LNAPL	Delineate extent of LNAPL and associated contamination in former lagoon area	- Install shallow subsurface soil borings extending radially from well MW-3 - Observe visually for LNAPL - Perform shake test - Screen with PID and collect soil samples - Install piezometers in the borings to observe for the thickness of LNAPL	- Borings to extend radially in 4 directions (N, E, S, W) from well MW-3 where LNAPL is currently present - 12 borings are estimated - Borings will be continued until there is no evidence of LNAPL - Additional soil borings may be installed if further delineation around MW-3 is needed or if LNAPL is found at other locations at the site. - Samples for the field shake test may be collected at other soil boring locations if there is visual evidence	RotaSonic	Estimated 12	To top of peat or approx. max depth 15-20 feet	3	36	- Surface (0-6") - Mid depth - Bottom of boring	- Soil cores will be screened with PID - Field shake test for LNAPL (all jars to be retained) - Samples selected for laboratory analysis based on PID readings and evidence of LNAPL - Samples to be analyzed for TCL organics & TAL metals - LNAPL thickness measurements
	Determine the characteristics of LNAPL material	Sample the LNAPL in well MW-3	MW-3	NA	1	NA	1	1	NA	- LNAPL fingerprinting (GRO and DRO) - TCL organics & TAL metals - Hazardous waste characteristics - Full TCLP - Specific gravity
Surface and sub-surface soil	- Investigate soil contamination (surface and subsurface above as well as below the peat/native organic soil layer) in areas where data is not available from previous investigations. - Investigate soil contamination (surface and subsurface above as well as below the peat/native organic soil layer) along the boundaries of the landfill.	- Install subsurface soil borings terminating at the peat layer - Install soil borings below the peat layer to approx.. 50 feet bgs - Perform downhole gamma logging of the borings installed below the peat layer	- Borings in an approximate grid in areas where there is currently no information - Borings along the upgradient and downgradient boundary of the landfill where change in slope is noted - Borings along the upgradient and downgradient boundary of the site - One boring outside of the perimeter of the site to investigate general soil conditions in the vicinity of the site - Actual locations to be selected in consultation with EPA after selected paths have been cleared from vegetation	RotaSonic	27	- 23 Shallow borings to top of peat (terminal depth approx. 15-20 feet) - 19 of these will be sampled and four will be completed as shallow wells without sampling. From the 19 borings that are sampled, 6 will also be completed as shallow wells. - 4 Deep borings below the peat (terminal depth approx. 50 feet) - borings will be sampled and completed as deep wells.	- Shallow borings - 3 per boring - Deep borings - 6 per boring	81	- Analyses will be for full TCL organics (VOCs, SVOCs, pesticides, and PCBs) and TAL metals. If warranted, samples will be analyzed for dioxins and furans in a subsequent phase of this investigation. - Shallow borings - surface (0-6"), mid depth, bottom of boring - Deep borings - surface (0-6"), mid depth of fill materials above peat, bottom of fill materials above peat, top of peat, bottom of peat, and bottom of boring	- Soil cores will be screened with PID - Samples selected for laboratory analysis based on PID readings and visual evidence of LNAPL - Samples to be analyzed for full TCL organics and TAL metals - Samples from fill materials, peat, and soil below the peat in the deep boring along the east border of the landfill tested for engineering parameters - Note that where a deep boring is installed next to a shallow boring for the purpose of constructing a monitoring well pair, sampling will be performed only in the deep boring - Note that if evidence of LNAPL is noted in any borings, the shake test will be performed and the boring may be completed as a piezometer - Where possible, boring locations will be selected in a 100-foot grid

Exhibit 5
Summary of Proposed Investigation Activities for the Diamond Head Oil RI/FS
Kearny, NJ

Media	Objective of Sampling Program	Investigation Method	Selection of Sampling Locations	Drilling/ Sampling Method	Number of Investigation Locations	Depth of Investigation Method	Number of Samples per Location	Total number of samples	Sample depth	Analysis
Ground water	- Investigate groundwater contamination along the upgradient and downgradient boundaries of the site and along the upgradient and downgradient boundaries of the landfill.	Install monitoring wells in: - 10 of the shallow soil borings with screens from the water table to the top of the peat - approx. 20-foot length - 4 deep borings with estimated 10 or 20-foot length screens set at approx. 50 feet bgs	Locations were selected to provide information on groundwater contamination: - Along the upgradient boundary of the site - Upgradient of the landfill and downgradient of the lagoon area - Downgradient of the landfill and the site, in general	RotaSonic	14	- 10 shallow wells (terminal depth approx. 15-20 feet) - 4 deep wells (terminal depth approx. 50 feet)	NA	NA	NA	
		Develop the existing and new monitoring wells in preparation for sampling and develop all new piezometers	NA	NA	19	NA	NA	NA	NA	
		Evaluate the tidal influence at the site	Install pressure transducers in both the shallow and deep wells in the 4 well pairs	NA	8	NA	NA	NA	NA	Water levels will be recorded continuously for a period of one week.
		Collect 2 rounds of synoptic water level and LNAPL thickness measurements in all on site wells and piezometers	Locations are as follows: 5 existing wells, 10 new shallow wells, 4 new deep wells, and 12 new piezometers	NA	31	NA	NA	NA	NA	Rounds of water level measurements will be collected as follows: at the time transducers are installed and prior to the start of the groundwater sampling
		Collect one round of groundwater samples from existing and new monitoring wells	Sample using low-flow all existing and new monitoring wells	Low-flow	19	NA	1	19	Above and below peat	- All locations - field parameters, full TCL organics and TAL total metals - Samples from the well pair along the eastern boundary of the landfill for natural attenuation parameters - Field parameters will include pH, temperature, specific conductance, dissolved oxygen, turbidity, and redox potential.

Exhibit 5
Summary of Proposed Investigation Activities for the Diamond Head Oil RI/FS
Kearny, NJ

Media	Objective of Sampling Program	Investigation Method	Selection of Sampling Locations	Drilling/ Sampling Method	Number of Investigation Locations	Depth of Investigation Method	Number of Samples per Location	Total number of samples	Sample depth	Analysis
Surface water and sediments	- Investigate surface water and sediment contamination in areas at the site where data is not available from previous investigations and immediately downgradient from the site	Sample surface water and sediments at selected locations	Co-located samples will be collected where data gaps appear in the existing data and to obtain an appropriate distribution of data	Surface water - Hand Sediments - Ponar	10	Sediment 0-6"	One surface water and one sediment per location	- Onsite - 8 samples - Down-gradient of site - 2 samples		- All locations - field parameters, full TCL organics and TAL metals - Note that one of the downgradient locations will be selected where depositional environment is present at the junction of Franks Creek and the drainage ditch leaving the site
Other	Clearance of vegetation	Vegetation to be cleared along select paths								
	Wetland delineation	Site visit for observation and delineation of wetland areas	NA	NA	NA	NA	NA	NA	NA	Delineation is important to adjust possible sampling locations in order to minimize the impacts on the wetland areas.
	Prepare site map, survey wetland boundary, survey horizontal locations of all new sampling locations and existing monitoring wells, and survey vertical elevations of new and existing monitoring wells	- Survey work will be performed in two phases (first: site map, wetland delineation, and horizontal and vertical survey of existing wells; and second: horizontal and vertical survey of all new locations)	NA	NA	NA	NA	NA	NA	NA	NA
	Clear all locations in former reprocessing area for buried metal and non-metallic conduits or containers before starting drilling	Clearance to be performed in one phase of all locations except in former lagoon area, which has been filled								
RI-derived wastes	Characterize wastes for disposal	Sample contents of storage tank where IDW water will be stored and sample drums with drill cuttings	One sample from the storage tank and upto five samples from the drums with drill cuttings	Composite	6	NA	1	6	NA	Hazardous waste characteristics for water and Full TCLP for soil cuttings

Soil engineering analyses: see table for non-CLP analyses
Field parameters will include pH, temperature, specific conductance, dissolved oxygen, turbidity, and redox potential.
Groundwater natural attenuation analyses: see table for non-CLP analyses
Analyses for TCL Organics include analyses for VOCs, SVOCs, pesticides, and PCBs. If warranted, samples will be analyzed for dioxins and furans in a subsequent phase of this investigation.

Exhibit 6
QA Objectives for the Diamond Head Field Investigation

Parameter	*Measurement*	*Matrix*	*Method*	*Units*	*Precision*	*Accuracy*	*MDL or Sensitivity*	*Completeness (%)*
Temperature	Screening	Aqueous	Direct Field Measurement	°C	0.15	N/A	0.01	90
pH	Screening	Aqueous	Direct Field Measurement	Std. Units	0.1	N/A	0.01	90
Turbidity	Screening	Aqueous	Direct Field Measurement	NTU	2	N/A	0.1	90
DO	Screening	Aqueous	Direct Field Measurement	mg/L	0.2	N/A	0.01	90
ORP	Screening	Aqueous	Direct Field Measurement	MV	20	N/A	0.1	90
Specific Conductivity	Screening	Aqueous	Direct Field Measurement	Umhos/cm or mS/cm	0.5% of full scale*	N/A	0.001	90
Water Level LNAPL Thickness	Screening	Aqueous	Direct Field Measurement	Feet	0.05	N/A	0.01	90
TCL Organics (VOCs, SVOCs, Pesticides, PCBs)	Definitive	Soil	OLM04.2 (or latest revision)	ug/kg	Analytical precision: per CLP method Sampling precision: 30% RPD	Analytical accuracy: per CLP method Sampling accuracy: Qualifiers based on blank results	Analytical sensitivity: Compound specific per CLP method	90
		Aqueous	OLC0 3.2	ug/L	Analytical	Same	Same	90

Parameter	Measurement	Matrix	Method	Units	Precision	Accuracy	MDL or Sensitivity	Completeness (%)
			(or latest revision)		Precision: Same Sampling precision:20% RPD			
TAL Metals	Definitive	Soil	ILM04.1 (or latest revision)	mg/kg	Analytical Precision: Same Sampling Precision: 30%RPD	Same	Same	90
		Aqueous (total and dissolved)	ILM04.1 (or latest revision)	ug/L	Analytical Precision: Same Sampling Precision: 20%RPD	Same	Same	90
TOC	Definitive	Soil	SW-846 9060	mg/kg	30% RPD	+-30%R	NA	90
pH	Definitive	Soil	SW-846 9045C	NA	NA	NA	NA	90
Grain size **	Definitive	Soil	ASTMD422-63	%	NA	NA	NA	90
Bulk density**	Definitive	Soil	ASTMD698	lbs/ft3	NA	NA	NA	90
Alkalinity	Definitive	Aqueous	EPA 310.1	mg/L	20% RPD	+-25%R	NA	90
TSS	Definitive	Aqueous	EPA 160.2	mg/L	20% RPD	NA	NA	90
TDS	Definitive	Aqueous	EPA 160.1	mg/L	20% RPD	NA	NA	90
Hardness	Definitive	Aqueous	EPA 130.2	mg/L	20% RPD	NA	NA	90
Ferrous iron	Definitive	Aqueous	SM 3500-FE	mg/L	20% RPD	+-25%R	NA	90

Parameter	Measurement	Matrix	Method	Units	Precision	Accuracy	MDL or Sensitivity	Completeness (%)
			D(due to possible oxidation, a field kit is recommended)					
Ammonia	Definitive	Aqueous	EPA 350.1	mg/L	20% RPD	NA	NA	90
TKN	Definitive	Aqueous	EPA 351.2	mg/L	20% RPD	NA	NA	90
Nitrate	Definitive	Aqueous	EPA 352.1	mg/L	20% RPD	+-25%R	NA	90
Nitrite	Definitive	Aqueous	EPA 354.1	mg/L	20% RPD	+-25%R	NA	90
Phosphorous, Total	Definitive	Aqueous	EPA 365.3	mg/L	20% RPD	+-25%R	NA	90
Chloride	Definitive	Aqueous	EPA 325.2	mg/L	20% RPD	+-25%R	NA	90
Sulfate	Definitive	Aqueous	EPA 375.2	mg/L	20% RPD	+-25%R	NA	90
Sulfide	Definitive	Aqueous	EPA 376.1	mg/L	20% RPD	+-25%R	NA	90
Methane	Definitive	Aqueous	8015B or RSK 175	ug/L	20% RPD	+-25%R	NA	90
Ethane	Definitive	Aqueous	8015B or RSK 175	ug/L	20% RPD	+-25%R	NA	90
Ethene	Definitive	Aqueous	8015B or RSK 175	ug/L	20% RPD	+-25%R	NA	90
TOC	Definitive	Aqueous	SW 846 9060	mg/L	20% RPD	+-25%R	NA	90
BOD	Definitive	Aqueous	EPA 405.1	mg/L	20% RPD	NA	NA	90
COD	Definitive	Aqueous	EPA 410.1	mg/L	20% RPD	NA	NA	90
CO2	Definitive	Aqueous	8M 4500-CO2D	ug/L	20% RPD	+-25%R	NA	90

Notes:
%R = Percent Recovery

NTU = Nephelometric Turbidity Units
TCL = Target Compound List
VOCs = Volatile Organic Compounds

ASTM = American Society of Testing and Materials
MDL = Method Detection Limit
RPD = Relative Percent Difference
TAL = Target Analyte List
* Precision dependent on meter and scale.
** Geotechnical engineering parameters

N/A = Not Applicable
The precision, accuracy and sensitivity for the field parameters are based on the performance of the Multiprobe Water Quality Meter.

Exhibit 7
Summary of Planned
Samples for CLP Analyses and Associated Bottle Requirements
Diamond Head Oil RI/FS
Kearny, NJ

esignation	Total Number of Locations to be Sampled	Number of samples at specified depth	Depth	Total number of samples	Number of QA/QC samples	Analyses	Total number of samples including QA/QC	Type of bottles	Number of bottles per sample	Total number of bottles
Soil - Shallow borings										
SB	31	1	0-6"	31	-	VOCs				
				31	-	semi-VOCs				
				31	-	pesticides				
				31	-	PCBs				
				31	-	metals				
			Mid depth	31	-	VOCs				
				31	-	semi-VOCs				
				31	-	pesticides				
				31	-	PCBs				
				31	-	metals				
			Bottom of boring	31	-	VOCs				
				31	-	semi-VOCs				
				31	-	pesticides				
				31	-	PCBs				
				31	-	metals				
Soil - Deep borings										
SB	4	1	0-6"	4	-	VOCs				
				4	-	semi-VOCs				
				4	-	pesticides				
				4	-	PCBs				
				4	-	metals				
			Mid depth of fill materials above peat	4	-	VOCs				
				4	-	semi-VOCs				
				4	-	pesticides				
				4	-	PCBs				
				4	-	metals				
			Bottom of fill materials above peat	4	-	VOCs				
				4	-	semi-VOCs				
				4	-	pesticides				
				4	-	PCBs				
				4	-	metals				
			Top of peat	4	-	VOCs				
				4	-	semi-VOCs				
				4	-	pesticides				
				4	-	PCBs				
				4	-	metals				
			Bottom of peat	4	-	VOCs				
				4	-	semi-VOCs				
				4	-	pesticides				
				4	-	PCBs				
				4	-	metals				

Exhibit 7
Summary of Planned
Samples for CLP Analyses and Associated Bottle Requirements
Diamond Head Oil RI/FS
Kearny, NJ

Designation	Total Number of Locations to be Sampled	Number of samples at specified depth	Depth	Total number of samples	Number of QA/QC samples	Analyses	Total number of samples including QA/QC	Type of bottles	Number of bottles per sample	Total number of bottles
			Below peat	4	-	VOCs				
				4	-	semi-VOCs				
				4	-	pesticides				
				4	-	PCBs				
				4	-	metals				
TOTAL SOIL				117	23	VOCs	140	EnCore samplers and 2 oz clear glass wide mouth jar	3 samplers and 1 jar per sample	420 EnCore samplers and 152 jars
				117	23	semi-VOCs	140	8 oz amber glass wide mouth jar	1	140
				117	23	pesticides/PCBs	140	8 oz clear glass wide mouth jar	1	140
				117	23	metals	140	Same	1	140
				120	NA	Shake test	120	Same	1	120
Surface water										
SW	10	1	NA	10	-	VOCs				
				10	-	semi-VOCs				
				10	-	pesticides				
				10	-	PCBs				
				10	-	metals				
TOTAL SURFACE WATER				10	2	VOCs	12	40 ml vials with HCL	3	36
				10	2	semi-VOCs	12	1l amber glass Boston round jar	2	24
				10	2	pesticides/PCBs	12	1l amber glass Boston round jar	2	24
				10	2	metals	12	500 ml poly narrow mouth with HNO3	1	12

Exhibit 7
Summary of Planned
Samples for CLP Analyses and Associated Bottle Requirements
Diamond Head Oil RI/FS
Kearny, NJ

Designation	Total Number of Locations to be Sampled	Number of samples at specified depth	Depth	Total number of samples	Number of QA/QC samples	Analyses	Total number of samples including QA/QC	Type of bottles	Number of bottles per sample	Total number of bottles
Sediment										
SD	10	1	0-6"	10	-	VOCs				
				10	-	semi-VOCs				
				10	-	pesticides				
				10	-	PCBs				
				10	-	metals				
TOTAL SEDIMENT				10	2	VOCs	12	EnCore samplers and 2 oz clear glass wide mouth jar	3 samplers and 1 jar per sample	EnCore samplers and 13 jars
				10	2	semi-VOCs	12	8 oz amber glass wide mouth jar	1	12
				10	2	pesticides/ PCBs	12	8 oz clear glass wide mouth jar	1	12
				10	2	metals	12	Same	1	12
Groundwater										
MW	19	1	Above and below peat	19	-	VOCs				
				19	-	semi-VOCs				
				19	-	pesticides				
				19	-	PCBs				
				19	-	total metals				
				2	-	dissolved metals				
TOTAL GROUNDWATER				19	4	VOCs	23	40 ml vials with HCL	3	69
				19	4	semi-VOCs	23	1l amber glass Boston round jar	2	46
				19	4	pesticides/ PCBs	23	1l amber glass Boston round jar	2	46
				19	4	total metals	23	'500 ml poly narrow mouth with HNO3	1	23

Exhibit 7
Summary of Planned
Samples for CLP Analyses and Associated Bottle Requirements
Diamond Head Oil RI/FS
Kearny, NJ

Designation	Total Number of Locations to be Sampled	Number of samples at specified depth	Depth	Total number of samples	Number of QA/QC samples	Analyses	Total number of samples including QA/QC	Type of bottles	Number of bottles per sample	Total number of bottles
				2		dissolved metals	2	500 ml poly narrow mouth with HNO3	1	2

Note: The number of QA/QC samples included in this table is an estimate set at 20% of the total number of samples that are planned to be collected at the site. If additional samples are collected based on field observations, the number of QA/QC samples may be higher than the numbers in this table.

Exhibit 8
Summary of Planned Samples for non-CLP Analyses to be Used in Engineering Evaluations of Remedial Alternatives Diamond Head Oil RI/FS
Kearny, NJ

Number of samples	Analyses	Analytical Method	Type of bottles	Preservation	Number of bottles per sample	Total number of bottles
Subsurface Soil						
3	TOC	SW-846 9060	8 oz glass jar	4°C	1	3
3	pH	SW-846 9045C	4 oz. glass jar	4°C	1	3
3	Grain size	ASTM D422-63	16 oz. glass jar	NR	1	3
3	Bulk density	ASTM D698-00	4 oz. glass jar	NR	1	3
Groundwater						
2	Alkalinity	EPA 310.1	250 ml polyethylene	4°C	1	2
2	TSS	EPA 160.2	500 ml Polyethylene	4°C	1	2
2	TDS	EPA 160.1	500 ml polyethylene	4°C	1	2
2	Hardness	EPA 130.2	250 ml polyethylene	H_2SO_4 to pH <2, 4°C	1	2
2	Ferrous iron	SM 3500-FE D	100 ml polyethylene	4°C	1	2
2	Ammonia	EPA 350.1	250 ml Polyethylene	H_2SO_4 to pH <2, 4°C	1	2
2	TKN	EPA 351.2	500 ml Polyethylene	H_2SO_4 to pH <2, 4°C	1	2
2	Nitrate	EPA 353.2	100 ml polyethylene	4°C	1	2
2	Nitrite	EPA 354.1	100 ml polyethylene	4°C	1	2
2	Phosphorous, Total	EPA 365.3	100 ml Polyethylene	H_2SO_4 to pH <2, 4°C	1	2
2	Chloride	EPA 325.20	100 ml Polyethylene	4°C	1	2
2	Sulfate	EPA 375.2	100 ml Polyethylene	4°C	1	2
2	Sulfide	EPA 376.1	250 ml Polyethylene	4°C, Zn acetate, NaOH to pH>9	1	2
2	Methane	8015B or RSK 175	40 mL glass vials	4°C	3	6
2	Ethane	8015B or RSK 175	40 mL glass vials	4°C	3	6
2	Ethene	8015B or RSK 175	40 mL glass vials	4°C	3	6
2	TOC	SW-846 9060	100 ml polyethylene	HCl to pH<2, 4°C	1	2
2	BOD	EPA 405.1	1 L Polyethelene	4°C	1	2
2	COD	EPA 410.1	100 ml polyethylene	H_2SO_4 to pH <2, 4°C	1	2
2	CO2	8M 4500-CO2D	40 mL glass vials	4°C	1	2
LNAPL						
1	TCL-VOCs	8260	40 ml vials	cool to 4°C	3	3
1	TCL-semi-VOCs	8270	8 oz amber glass	cool to 4°C	1	1
1	TCL-pesticides/ PCBs	8081	8 oz clear glass	cool to 4°C	1	1
1	TAL-metals	8260	8 oz clear glass	cool to 4°C	1	1
1	GRO & DRO	8015	8 oz clear glass	cool to 4°C	2	2
1	Haz waste characteristics - Ignitability	1010				
1	Haz waste characteristics - corrosivity	9045	8 oz clear glass	cool to 4°C	1	1
1	Haz waste characteristics - reactivity	7.3.3.2				
1	Full TCLP	1311/8000/6000	8 oz clear glass	cool to 4°C	3	3

Exhibit 8
Summary of Planned Samples for non-CLP Analyses to be Used in Engineering Evaluations of Remedial Alternatives Diamond Head Oil RI/FS
Kearny, NJ

Number of samples	Analyses	Analytical Method	Type of bottles	Preservation	Number of bottles per sample	Total number of bottles
1	Specific gravity	2710				
Waste Materials						
1	Haz waste characteristics - Ignitability	1010	8 oz clear glass	cool to 4°C	1	1
1	Haz waste characteristics - corrosivity	9045				
1	Haz waste characteristics - reactivity	7.3.3.2				
5	Full TCLP	1311/8000/6000	8 oz clear glass	cool to 4°C	3	15

Exhibit 9
Summary of Analytical Program
Diamond Head RI/FS

Media sampled	Analyses	Analytical Method	Laboratory performing analysis	Type of bottles	Number of bottles per sample	Preservation	Amount of Preservative	Sample Holding Time
Soil and Sediment	VOCs	OLM04.2	CLP	EnCore samplers	3	4°C	-	48 hours
				2 oz clear glass wide mouth jar	1	4°C	-	
	semi-VOCs	OLM04.2	CLP	8 oz amber glass wide mouth jar	1	4°C	-	14 days to extraction then 40 days from extraction to analysis
	pesticides and PCBs	OLM04.2	CLP	8 oz clear glass wide mouth jar	1	4°C	-	14 days to extraction then 40 days from extraction to analysis
	metals	ILM04.1	CLP	8 oz clear glass wide mouth jar	1	4°C	-	6 months
Soil	TOC	SW-846 9060	Subcontracted lab	8 oz glass jar	1	4°C	-	28 days
	pH	SW-846 9045C	Subcontracted lab	4 oz. glass jar	1	4°C	-	NR
	Grain size	ASTM D422-63	Subcontracted lab	16 oz. glass jar	1	NR	-	NR
	Bulk density	ASTM D698-00	Subcontracted lab	4 oz. glass jar	1	NR	-	NR
Groundwater and Surface Water	VOCs	OLC03.2	CLP	40 ml vials	3	HCL to pH<2, 4oC	0.5 mL	14 days
	semi-VOCs	OLC02.0	CLP	1l amber glass Boston round jar	2	4°C	-	7 days to extraction and 40 days from extraction to analysis
	pesticides and PCBs	OLC02.0	CLP	1l amber glass Boston round jar	2	4°C	-	7 days to extraction and 40 days from extraction to analysis
	metals (total or dissolved)	ILM04.1	CLP	500 ml poly narrow mouth	1	HNO3 to pH <2, 4oC	3 mL	6 months
Groundwater	Alkalinity	EPA 310.1	Subcontracted lab	250 ml polyethylene	1	4°C	-	14 days
	TSS	EPA 160.2	Subcontracted lab	500 ml Polyethylene	1	4°C	-	7 days
	TDS	EPA 160.1	Subcontracted lab	500 ml polyethylene	1	4°C	-	7 days
	Hardness	EPA 130.2	Subcontracted lab	250 ml polyethylene	1	H_2SO_4 to pH <2, 4°C	0.3 mL	6 months
	Ferrous iron	SM 3500-FE D	Subcontracted lab	100 ml polyethylene	1	4°C	-	Upon receipt by laboratory
	Ammonia	EPA 350.1	Subcontracted lab	250 ml Polyethylene	1	H_2SO_4 to pH <2, 4°C	1 mL	28 days
	TKN	EPA 351.2	Subcontracted lab	500 ml Polyethylene	1	H_2SO_4 to pH <2, 4°C	1 mL	28 days
	Nitrate	EPA 353.2	Subcontracted lab	100 ml polyethylene	1	4°C	-	48 hours
	Nitrite	EPA 354.1	Subcontracted lab	100 ml polyethylene	1	4°C	-	48 hours
	Phosphorous, Total	EPA 365.3	Subcontracted lab	100 ml Polyethylene	1	H_2SO_4 to pH <2, 4°C	0.5 mL	28 days
	Chloride	EPA 325.2	Subcontracted lab	100 ml Polyethylene	1	4°C	-	28 days
	Sulfate	EPA 375.2	Subcontracted lab	100 ml Polyethylene	1	4°C	-	28 days
	Sulfide	EPA 376.1	Subcontracted lab	250 ml Polyethylene	1	4°C, Zn acetate, NaOH to pH>9	1.5 mL NaOH + 2 mL Zn acetate	7 days
	Methane	8015B or RSK 175	Subcontracted lab	40 mL glass vials	3	4°C	-	14 days
	Ethane	8015B or RSK 175	Subcontracted lab	40 mL glass vials	3	4°C	-	14 days
	Ethene	8015B or RSK 175	Subcontracted lab	40 mL glass vials	3	4°C	-	14 days
	TOC	SW-846 9060	Subcontracted lab	100 ml polyethylene	1	H2SO4 to pH<2, 4°C	0.3 mL	28 days
	BOD	EPA 405.1	Subcontracted lab	1 L Polyethelene	1	4°C	-	48 hours
	COD	EPA 410.1	Subcontracted lab	100 ml polyethylene	1	H_2SO_4 to pH <2, 4°C	0.3 mL	28 days
	CO2	SM 4500-CO2D	Subcontracted lab	40 mL glass vials	1	4°C	-	14 days
LNAPL	TCL-VOCs	8260	Subcontracted lab	40 ml vials	3	cool to 4°C	-	48 hours
	TCL-semi-VOCs	8270	Subcontracted lab	8 oz glass	1	cool to 4°C	-	14 days to extraction then 40 days from extraction to analysis

Exhibit 9
Summary of Analytical Program
Diamond Head RI/FS

Media sampled	Analyses	Analytical Method	Laboratory performing analysis	Type of bottles	Number of bottles per sample	Preservation	Amount of Preservative	Sample Holding Time
	TCL-pesticides/ PCBs	8081	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	14 days to extraction then 40 days from extraction to analysis
	TAL-metals	8260	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	6 months
	GRO & DRO	8015	Subcontracted lab	8 oz clear glass	2	cool to 4°C	-	14 days
	Haz waste characteristics - Ignitability	1010	Subcontracted lab					
	Haz waste characteristics - corrosivity	9045	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	14 days
	Haz waste characteristics - reactivity	7.3.3.2	Subcontracted lab					
	Full TCLP	1311/8000/6000	Subcontracted lab	8 oz clear glass	3	cool to 4°C	-	14 days
	Specific gravity	2710	Subcontracted lab					
Investigation Derived Waste (solid)	Haz waste characteristics - Ignitability	1010	Subcontracted lab					
	Haz waste characteristics - corrosivity	9045	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	14 days
	Haz waste characteristics - reactivity	7.3.3.2	Subcontracted lab					
	Full TCLP	1311/8000/6000	Subcontracted lab	8 oz clear glass	3	cool to 4°C	-	14 days

Pre-preserved bottles will be used for all samples requiring chemical preservation.

Sample bottles for analyses subcontracted outside of CLP, will be provided by the laboratories selected to perform the analyses.

Field QA/QC samples will be collected as follows:

Duplicate samples - 1/10 or a minimum of one per week. Collect weekly duplicate at the start of the week and each time after that, that 10 samples have been collected. Duplicates are two discrete samples collected at the same location.

Additional volume for MS/MSD samples - Collect 1 additional sample volume for soil and two additional sample volumes for groundwater. Frequency is 1/20 or a minimum of one per week. Duplicate samples and MS/MSD samples should not be collected from the same sampling location. Collect MS/MSD at the start of the week and each time after that, that 20 samples have

Trip blanks: Trip blanks must accompany each shipment of aqueous samples for VOC analyses. Trip blanks are collected using two 40-ml VOC vials.

Field blanks: 1/each decontamination event per type of sampling equipment not to exceed one per day. Field blanks are collected using the same types of bottles as the groundwater

Temperature blanks: A temperature blank must accompany each sample shipment. The temperature blank consists of one unpreserved 40 ml vial.

H_2SO_4 used is concentrated. HCL and HNO_3 are diluted 1:1 by volume.

Exhibit 10
Field Change Request (FCR) Form

Project Name: Diamond Head Oil Superfund Site ______ **Request Number:** FCR-__________

Field Change Request Title: ____

To: ____

Date: ____

Description:

Reason for Change:

Recommended Disposition

Field Team Leader (or designee): ____
Signature Date

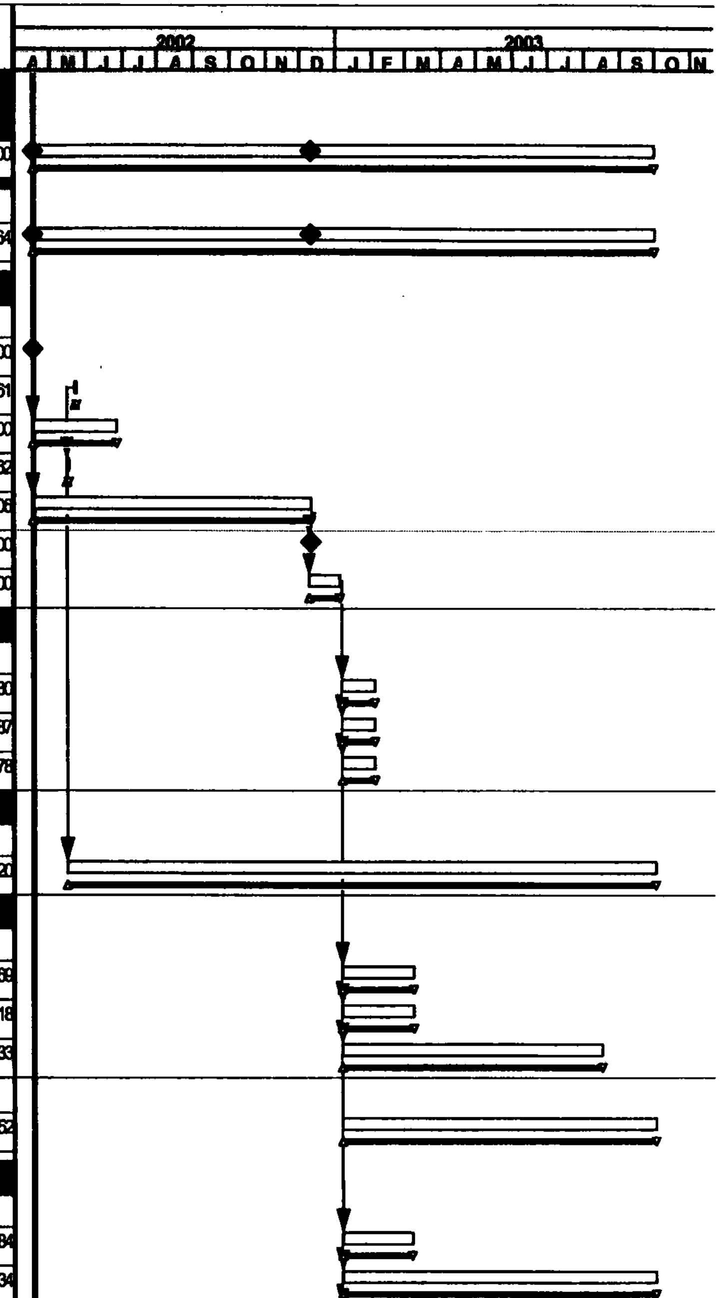
Disposition:

Project Manager: ____
Signature Date

Approval EPA Project Manager: ____
Signature Date

Distribution:
EPA Project Manager
Project QA Officer
CH2M HILL Project Manager
Field Operations Lead
Other:

Activity ID	Activity Description	% Comp	Orig Dur	Early Start	Early Finish	Budgeted LOEH	Budgeted Cost
Diamond Head							
173044 - Diamond Head (112)							
Subtotal		0	381	16APR02	30SEP03	7,738.00	1,135,997.00
Task 1 (PP) - Project Planning and Support							
Subtotal		0	381	16APR02	30SEP03	2,544.00	284,927.64
(PP.WP) - Work Planning							
PPWP005	Receive Work Assignment	0	0	16APR02		0.00	0.00
PPWP010	Attend Kickoff/Scoping Meeting	0	1	22MAY02*	22MAY02	87.00	10,242.61
PPWP020	Evaluate Existing Information	0	52	16APR02	26JUN02	125.00	13,965.00
PPWP030	Conduct Site Visit	0	1	16MAY02	16MAY02	32.00	4,182.62
PPWP040	Develop RI/FS Work Plan and Cost Estimate	0	171	16APR02	10DEC02	390.00	43,460.06
PPWP045	Submit Work Plan to EPA	0	0		10DEC02	0.00	0.00
PPWP046	EPA Approval of Work Plan	0	19	10DEC02	03JAN03	0.00	0.00
(PP.SP) - Site Specific Plans							
PPSP010	Develop Site Mangement Plan	0	21	06JAN03	03FEB03	80.00	8,102.30
PPSP020	Develop Health and Safety Plan	0	21	06JAN03	03FEB03	20.00	2,122.87
PPSP030	Develop Sampling and Analysis Plan	0	21	06JAN03	03FEB03	425.00	47,965.78
(PP.PM) - Project Management							
PPPM010	Prepare Monthly Status Reports	0	359	16MAY02	30SEP03	336.00	39,466.20
(PP.SU) - Procurement of Subcontracts							
PPSU010	Identification and Procurement of Subcontractors	0	45	06JAN03	07MAR03	367.99	39,369.69
PPSU020	Develop Subcontractor QA/QC Program	0	45	06JAN03	07MAR03	191.99	23,988.18
PPSU030	Perform Subcontractor Management	0	160	06JAN03	15AUG03	489.02	52,062.33
Task 2 (CR) - Community Relations							
Subtotal		0	192	06JAN03	30SEP03	184.00	21,745.52
(CR.CR) - Community Relations							
CRCR010	Community Relations Plan	0	44	06JAN03	06MAR03	72.00	8,532.84
CRCR020	Public Meeting Support	0	192	06JAN03	30SEP03	56.00	6,606.34



Start Date	16APR02
Finish Date	30SEP03
Data Date	16APR02
Run Date	10DEC02 14:46

Early Bar
Target Bar
Progress Bar
Critical Activity

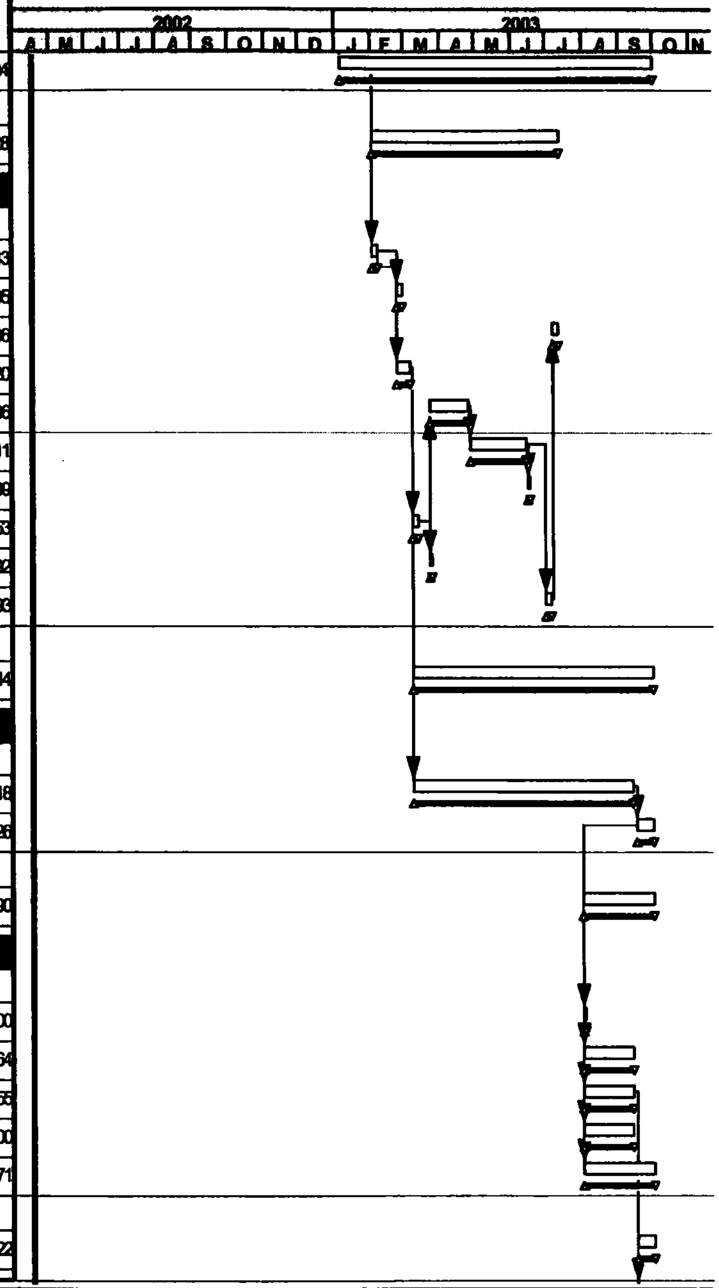
1120

Exhibit 11

US EPA Region 6

Response Action Contract

Activity ID	Activity Description	% Comp	Orig Dur	Early Start	Early Finish	Budgeted LOEH	Budgeted Cost
CRCR030	Fact Sheets Preparation	0	192	06JAN03	30SEP03	56.00	6,608.34
Task 3 (FI) - Field Investigation							
Subtotal		0	115	03FEB03	11JUL03	2,794.00	589,122.28
(FI.FI) - Field Investigation							
FIFI010	Identify Field Sprt. Equip, Supplies, Facilities	0	5	03FEB03	07FEB03	172.00	16,185.43
FIFI020	Mobilization	0	5	24FEB03	28FEB03	290.00	57,513.95
FIFI030	Demobilization	0	5	07JUL03	11JUL03	106.00	10,998.86
FIFI040	Perform Site Reconnaisance	0	10	24FEB03	07MAR03	226.00	47,045.20
FIFI050	Conduct Geological Investigations	0	25	24MAR03	25APR03	1,192.00	299,445.36
FIFI060	Conduct Hydrogeological Investigations	0	35	28APR03	13JUN03	462.00	66,499.11
FIFI070	Conduct Waste Investigation	0	1	16JUN03	16JUN03	18.00	2,306.99
FIFI080	Conduct Utility Clearance	0	5	10MAR03	14MAR03	44.00	12,421.53
FIFI090	Conduct Ecological Investigation	0	2	24MAR03	25MAR03	152.00	18,490.92
FIFI100	Dispose of Investigation-Derived Waste	0	5	30JUN03	04JUL03	132.00	58,214.93
Task 5 (AN) - Analytical Sppt / Data Validation							
Subtotal		0	147	10MAR03	30SEP03	236.00	24,226.44
(AN.AN) - Analytical Sppt/Data Validation							
ANAN010	Sample Management	0	135	10MAR03	12SEP03	201.00	20,531.18
ANAN020	Data Validation	0	12	15SEP03	30SEP03	35.00	3,695.26
Task 6 (DE) - Data Evaluation							
Subtotal		0	43	01AUG03	30SEP03	1,619.00	172,305.90
(DE.DE) - Data Evaluation							
DEDE005	Receive Data From EPA	0	1	01AUG03	01AUG03	0.00	0.00
DEDE010	Data Usability Evaluation	0	30	01AUG03	11SEP03	92.00	9,626.64
DEDE020	Data Reduction, Tabulation and Evaluation	0	30	01AUG03	11SEP03	875.00	91,491.55
DEDE030	Modeling	0	30	01AUG03	11SEP03	0.00	0.00
DEDE040	Technical Memorandum (Data Evaluation Report)	0	43	01AUG03	30SEP03	652.00	71,187.71
Task 7 (RA) - Assessment of Risk							
Subtotal		0	12	15SEP03	30SEP03	361.00	43,669.22



Start Date	16APR02
Finish Date	30SEP03
Data Date	16APR02
Run Date	10DEC02 14:46

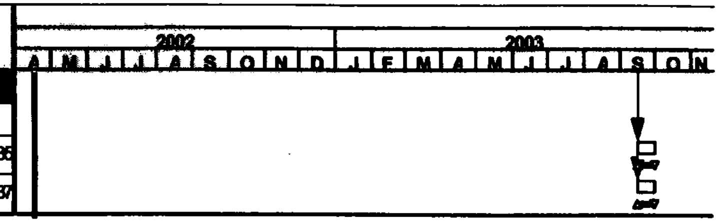
Early Bar
Target Bar
Progress Bar
Critical Activity

1120 Sheet 2 of 3

US EPA Region 6

Response Action Contract

Activity ID	Activity Description	% Comp	Orig Dur	Early Start	Early Finish	Budgeted LOEH	Budgeted Cost
(RA.RA) - Assessment of Risk							
RARA010	Draft Human Health Risk Assessment Report	0	12	15SEP03	30SEP03	66.00	7,139.36
RARA020	Draft Ecological Risk Assessment Report	0	12	15SEP03	30SEP03	295.00	36,529.87



Start Date	16APR02	Early Bar	1120
Finish Date	30SEP03	Target Bar	Sheet 3 of 3
Data Date	16APR02	Progress Bar	US EPA Region 6
Run Date	10DEC02 14:46	Critical Activity	Response Action Contract

ATTACHMENT A

Site Management Plan

ATTACHMENT A
Diamond Head Remedial Investigation Site Management Plan

Contents

Introduction

This Site Management Plan represents a combined Pollution Control and Mitigation Plan and Transportation and Disposal Plan for the remedial investigation activities conducted at the Diamond Head Oil site in Kearny, New Jersey. In addition, the plan describes the site management procedures, which will be followed during the remedial investigation activities. The plan contains sections describing the following:

- Responsibilities for overall project management and management of the remedial investigation activities
- Status updates on ongoing activities
- Project contacts and lines of communication
- Communications with State and local officials, property owner, and the surrounding community
- Facilities, which will be brought to the site in support of field operations
- Security procedures to be followed during the onsite activities
- Procedures to follow in accommodating of site visitors
- Compliance with Health and Safety Plan requirements
- Vegetation clearance and procedures to control tick exposures
- Utility connections
- Onsite management of IDW
- Disposal of the IDW

- Responding to non-emergency spills from the remedial investigation activities
- References and onsite availability of resources in the onsite trailer

Management Responsibilities

The EPA Project Manager is Grisell Diaz-Cotto. The CH2M Hill Project Manager is Juliana Hess. Juliana Hess has overall responsibility for CH2M HILL's execution of the project. The remedial investigation Lead is Andy Judd. He is responsible for technical oversight of the project and implementation of the field investigation program. Mr. Judd will also serve as the Sample Management Coordinator. The RI Field Team Lead is John Loeffel. He is responsible for the ongoing day-to-day activities at the site. At times, there may be more than one CH2M HILL person working on the same activity at the site. If this is the case, one person will be assigned the leader role for the activity. The responsibilities of the various project team members are as follows:

- The Project Manager has primary responsibility and authority for:
  - Implementing and executing the technical, quality and administrative aspects of the project, including the management of the project team.
  - Maintaining the SAP (including QAPP and FSP) and ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including the Work Plan, this SAP, and the Health and Safety Plan (HSP).
  - Communicating all technical, QA and administrative matters to the EPA.
  - Documenting any deviations from the approved Work Plan, this SAP, and the HASP in Field Change Requests (FCRs) forms and in the monthly progress reports and communicating these to the EPA for approval.
  - Procuring subcontractors who have the appropriate qualifications to provide the required services.
  - Supporting the RI Lead and Field Team Lead (FTL) during the filed activities.

- The site-specific Health and Safety Officer will be a member of the CH2M HILL on-site field team who will have the responsibility for the implementation of the Health and Safety Plan while onsite activities are underway. This will include monitoring the work environment in accordance with the requirements in the plan and recording the results of this monitoring.

- The RI Lead reports directly to the PM and will be supported by the Field Team Lead and by field technical staff who will perform the RI activities. The RI Lead will be responsible for:
  - Implementing the field investigation.
  - Monitoring the quality and timeliness of all RI activities, including those performed by subcontractors.
  - Implementing the Work Plan and SAP in order to ensure that the acquired data meet the data quality objectives.
  - Verifying the qualifications of suppliers and subcontractors relative to project objectives and special requirements, and advising staff and subcontractors of their roles and responsibilities towards achieving the project objectives.

  - Ensuring that all field staff possess the appropriate training prior to collecting environmental samples and that staff and subcontractors are cognizant of and comply with the contractual and regulatory requirements applicable to onsite activities (e.g., Department of Transportation [DOT] regulations, Resource Conservation and Recovery Act [RCRA] requirements for waste management). When necessary, the RI Lead will document any deviations from the plans and procedures in FCRs and submit them to the PM.

- The FTL will report to the RI Lead and will be supported by field technical staff who will perform the RI activities. The FTL will be responsible for:

  - Overseeing the day-to-day implementation of the RI activities from their onset to completion. RI activities include vegetation clearance, utility clearance, surveying, boring and well installation, sample collection and field testing, sample management, and hydrogeologic testing.
  - Implementing the Work Plan and SAP in order to ensure that the acquired data meet the data quality objectives. When necessary, the FTL will document any deviations from the plans and procedures in FCRs and submit them to the RI Lead.

- The Sample Management Coordinator (SMC) will have overall responsibility for the following:

  - Contact Jennifer Feranda/EPA RSCC or her designee with information on laboratory requirements on Tuesday the week prior a scheduled sampling event;

  - Track number of samples collected in order to collect the correct number of QC samples including MS/MSDs, sample duplicates, trip blanks and equipment rinsate blanks per case or sampling event;

  - Contact Heather Bauer, the SMO, nightly with information on samples shipped that day;

  - Contact Heather Bauer/SMO by 3 PM on Friday if samples are shipped for Saturday Delivery; Note on FedEx forms and place Saturday Delivery Stickers on coolers; Inform FedEx of Saturday delivery requirements when the coolers are dropped off at FedEx.

  - Coordinate and assist with EPA (Jennifer Feranda, Heather Bauer, etc.) any sample management related issues.

  - Prepare Sample Trip Report (Case Summaries) in Word Perfect format for each case number and submit to Jennifer Feranda (electronic copy via email and paper copy via regular mail) within 3 weeks of sampling.

  - Submit "Region" copies of each Chain of Custody (COCs) to Heather Bauer within 3 weeks of sampling.

  - Review data packages as they are received; Sign and date "RECORD OF COMMUNICATION" form that accompanies each data package and submit to Janet

Trotter.

- Update the sample tracking table.

- The project chemist will support the procurement and management of the subcontracted laboratories on an as needed-basis, and will provide technical guidance, as requested, during the RI activities. He will also perform the review of the data quality after all the validated analytical results are received.

- Field technical staff will be assigned to the project on an as needed-basis to perform the RI activities as directed by the FTL and/or the RI Lead.

Remedial Investigation Status Updates

During the field activities, the RI Lead and / or the FTL is responsible for contacting the CH2M HILL Project Manager to provide a daily update of that day's field activities. The update will include:

- The borings/sampling completed that day
- Deviations from the planned sampling (e.g., boring locations, number of samples)
- Deviations from the procedures in the QAPP / FSP
- Problems encountered and whether they were resolved
- Any assistance needed
- Subcontractor performance
- Any anticipated effects on the project schedule and budget
- Any visitors to the site or contacts/requests made by State, local, or community members

Exhibit A-1 in the Site Management Plan in Attachment A contains the information that will be provided in the daily status report. The Project Manager may use this Exhibit to record the information or keep a record in her phone conversion logbook.

On a 10-day drilling cycle- basis, the RI Lead will also provide the Project Manager with a copy of the sample log, which the Project Manager will use to track samples and a written report of the activities completed during that cycle. After review of the progress report, a copy will be forwarded to the EPA Project Manager. In addition, a written monthly progress report will be submitted to the EPA.

Project Contacts and Lines of Communication

Exhibit A-2 provides the list of EPA and CH2M HILL project contacts. As subcontractor services are procured, contacts for each of these subcontracts and onsite utilities will be added to the list. An up-to-date list will be maintained in the onsite trailer.

The lines of communication will be as follows:

Field person to FTL
If RI/FTL is not available, field person to CH2M HILL's Project Manager
FTL to RI Lead

If RI Lead is not available, FTL to CH2M HILL Project Manager
RI Lead to CH2M HILL Project Manager
CH2MHILL Project Manager to EPA Project Manager
If CH2M HILL Project Manager is not available, RI Lead to EPA Project Manager

In case of an emergency and if the RI Lead and FTL are not available, the CH2M HILL field person is to follow procedures in the HASP and contact the EPA Project Manager directly.

Communications with State and Local Agencies, Property Owner and the Surrounding Community

The field person will direct all requests for information made directly to him/her from State and local agencies, the property owner and his representative, and the surrounding community following the lines of communication noted above. Communications will be immediate . The CH2M HILL Project Manager is responsible for informing the EPA Project Manager of the requests. The CH2M HILL Project Manager will respond to a request only after being directed to do so by the EPA Project Manager.

Support Facilities and Equipment and Supplies Storage and Recordkeeping

The following facilities will be rented and staged at the site for the duration of the remedial investigation:

- Dumpster for general trash
- 21,000-gallon storage tank for RI-derived water
- 1,000-gallon storage tank for clean water.
- Office trailer with a water cooler for potable water
- Equipment storage container
- Portable sanitary facility
- Ice chest for storage of bulk sample preservation ice

Exhibit A-3 is a site plan showing the general area where the field facilities will be located. Of note, all facilities will be located at the front of the property where there is no indication that previous site operations or landfilling activities took place.

The office trailer will be provided with desks, chairs, tables, filing cabinet, a telephone, a computer, and a combined fax / printer. This computer will be used by all field staff to connect to the office and receive and send emails.

The following supplies will be maintained in the trailer:

- First aid
- Eye wash station
- Fire extinguisher
- Spill cleanup supplies for non-emergency spills (e.g., kitty litter)

Equipment, supplies, and chemicals for the field investigation will be stored in a storage container. The chemicals will be segregated in different section of the storage container.

The RI Lead/FTL are responsible for reviewing the Material Safety Data Sheets (MSDSs) for the chemicals and for designating the location where each chemical will be stored such that incompatible chemicals are segregated. The RI Lead/FTL will indicate this area to all onsite field personnel and instruct them to store chemicals only in this area. Spill cleanup supplies will also be maintained in the storage trailer.

Field parameter forms have been developed for documenting all performed field activities. The forms are included at the end of the SOPs, which they must be used to document. A complete set of the forms is also included in SOP No. 4 Field Parameter Forms. During the field investigation activities, field personnel must complete the appropriate forms. The forms must be filed at the end of each day in three-ring binders provided for each form in the on-site trailer. Upon completion of the field activities, the three-ring binders will be brought back to the CH2M HILL Parsippanny office and made part of the project documentation record.

Site Security

The site is surrounded by a fence with an access gate on Harrison Avenue. The gates will be locked at the end of each workday and unlocked at the start of the next workday. The gates may be left open during the day if site personnel feel that they have continuous control over site access (e.g., can visually observe the gates). If all personnel leave the site for a break, the gates will be closed and locked. The trailer will also be closed and locked when the gates are closed and locked.

Site Visitors

During the remedial investigation, official visitors such as the EPA Project Manager, an inspector from OSHA, or a representative from a State or local agency may visit the site (e.g., the NJDEP). The RI Lead and / or FTL is responsible for informing the official visitor, if they are not already familiar with site activities, that this is a hazardous waste investigation and in order to come onsite, they must have the appropriate training under OSHA. The RI Lead and / or FTL is then responsible for immediately contacting the CH2M HILL Project Manager to inform her of the official visitor and seek direction. Visitors other than the EPA Project Manager must be requested to wait in the trailer until this contact is made.

A site visitor log will be maintained in the trailer and all visitors will be required to register in this log upon arrival.

Community members and the property owner and his representative will not be permitted onsite unless they have received prior approval from the EPA Project Manager.

Exhibits A-4 and A-5 will be used for signing-in by the field staff and visitors.

Compliance with the Site Health and Safety Plan

A site-specific Health and Safety Plan has been developed. The Health and Safety Plan and the MSDSs for the chemicals, which will be used during the remedial investigation will be posted in the trailer. In addition, the following are to be posted in the trailer:

- OSHA job site poster
- Evacuation plan

- Emergency phone numbers

Emergency equipment specified in the plan (spill kit, first aid, fire extinguisher, and other emergency equipment) are to be unpacked on the first day of filed activities and stored at a readily accessible location.

All personnel participating in the filed activities are required to read the Health and Safety Plan before arriving at the site and signing the "sign-off sheet" attached to the back of the plan. In addition, a "Site Safety Briefing" must be held each time new personnel begin work on the field investigation. The personnel who attend the briefing must sign the "sign-off sheet".

CH2M HILL's Hazard Communication Program and associated SOPs are available on the CH2M HILL's Intranet site and can be accessed at the site, if needed.

Air Monitoring

Real-time air monitoring for VOCs will be conducted during tasks involving intrusive activities (e.g., boring, well installation). The monitoring program is described in detail in the HASP and the SAP. The air monitoring will be conducted for worker safety and will be associated with exposure action levels, which if exceeded, will trigger the need for corrective action. All air monitoring readings above 0 will be recorded in the field logbook. The field lead person is responsible for recording the readings along with the following information for each reading:

- Date
- Time
- Boring/well being installed
- Location of reading (e.g., worker zone, site perimeter)
- Any actions that needed to be taken based on the established action levels
- Any pertinent observations noted in the field logbook

Vegetation Clearance and Procedures to Control Exposures to Ticks

A vegetation clearance subcontractor will be retained to clear and remove from the site vegetation along several transects. The subcontractor will have the required training for working at a hazardous waste site and will be required to wear protective gear for minimizing tick exposures during their vegetation clearance activities.

All CH2M HILL field personnel will follow the requirements in the HASP for wearing protective clothing and spraying the clothing with tick repellant in order to minimize the potential for tick exposures. All spraying of the clothing will be done on a plastic sheet next to the trailer. The gloves used during the spraying and the plastic sheet onto which the spraying is done will be collected as IDW for disposal. No spraying is allowed at any other locations at the site in order to minimize the potential for any cross contamination of environmental samples. Clean gloves will be used by all field personnel for the collection of environmental samples.

Equipment Storage and Tracking

Equipment will be stored in the onsite trailer and storage container. Equipment will be tracked using the form in Exhibit A-6.

Utility Connections

The following utility connections will be provided:

- Electrical connection to the office trailer
- Telephone connection to the office trailer

CH2M HILL is responsible for coordinating these utility services for the duration of the remedial investigation activities. In case of service disruption, contacts for each of these services are provided on the project contacts list. The field lead person is responsible for contacting the utilities directly if service problems are experienced and for subsequently informing the RI/FTL and/or the CH2M HILL Project Manager of these issues.

In addition to the above utilities, subcontractor services will be procured for the following:

- Weekly removal of general trash
- Periodic supply of ice for sample packaging
- Period supply of bottled water for potable use by the field team
- Periodic supply of clean water for use in sampling activities and production of DI water for sampling; water will be stored in an onsite storage tank
- Field sanitary facility and weekly servicing of this facility

Onsite Management of Investigation Derived Waste (IDW)

Exhibit A-7 lists the IDW streams expected from the remedial investigation and provides instructions on how to manage each waste stream.

The IDW storage area will be established at the front of the property. Within this area, separate areas will be designated for the storage of each type of waste stream. All IDW will be brought to this area immediately upon generation and placed in drums. The different IDW streams will be segregated in separate drums. No mixing of the different IDW streams is permitted. After the IDW is placed in the drum, the drum will be immediately closed. Drums will be opened only when waste is to be placed in them.

Fifty-five gallon, open top, type 17E (1A2) of Department of Transportation (DOT)-approved drums will be used for the onsite storage and offsite transport and disposal of all wastes other than RI-derived water.

The driller will be responsible for supplying drums of the required specification, to support the remedial investigation.

The field lead person is responsible for marking the following information on each drum:

- Type of IDW (see Exhibit for abbreviations to use)
- Unique drum number incorporating waste source location
- Date waste was first placed in drum
- Date when waste was last placed in drum
- % Fullness of drum
- % Water of drum contents
- % Solids of drum contents

The following is an example of an IDW drum label for the third drum of soil cuttings from boring location SB-1 where the drum is 80% full and the muddy cuttings consist of 40% water and 60% soil, and it took two days to fill the drum.

IDW – Soil
SB-1 – 3
1/1/01 – 1/2/01
80F/40W/60S

A logbook will be maintained in the field trailer on the IDW storage area. As the drums are brought to the drum storage area, the information from the drum label will be recorded into the logbook. If any particulars of the IDW are observed, which may affect its management and disposal, the field lead person will note them in the logbook in addition to marking all the above information on the drums.

The field lead person is responsible for inspecting daily the IDW storage area to ensure that all drums are properly closed and there are no leaks or spills from the drums. Any spills or leaks at the drum storage area will be managed following the spill response procedures described in this Site Management Plan.

RI-derived water generated during the investigation will be brought to a 21,000-gallon storage tank located at the site. The water will be stored in the tank until the end of the remedial investigation activities, when a subcontract for its disposal will be procured.

Disposal of IDW

Upon completion of the remedial investigation activities, CH2M HILL will:

- Inventory the drums accumulated at the IDW storage area;
- In consultation with EPA, make a determination on the classification of the different IDW streams;
- Procure a subcontract for the disposal of all IDW streams (drums and water in the onsite storage tank);
- Oversee the preparation of disposal paperwork and the removal of the drums from the site.

Spill Response

In case of a spill on an unpaved surface, the field lead person is responsible for IMMEDIATELY notifying the CH2M HILL Project Manager of the spill. The CH2M HILL

Project Manager in turn is will be responsible for IMMEDIATELY notifying the EPA Project Manager of the spill. Reporting of the spill to the NJDEP will be by the EPA Project Manager. NOTE THAT REPORTING OF SPILLS TO THE NJDEP MUST BE MADE WITHIN 15 MINUTES OF THE OCCURRENCE OF THE SPILL SO IT IS ESSENTIAL THAT ALL NOTIFICATIONS IN THIS SEQUENCE HAPPEN IMMEDIATELY. If the onsite person cannot contact the CH2M HILL Project Manager, he/she will contact directly the EPA Project manager.

Onsite personnel are responsible for cleaning-up any accidental spills of chemicals, which are used during the RI activities as long as the spills do not represent "emergencies", evaluating the spill conditions and for reviewing the MSDS for the chemical to determine if the spill constitutes an emergency. Non-emergency spills will be cleaned up following the procedures in the MSDS for the spilled chemical. The generated waste will be collected in a drum separate from the drums where drill cuttings and other solid-phase wastes are accumulated. This drum will be labeled "Spill waste". In case of emergency spills, emergency phone numbers are available in the Health and Safety Plan. The field lead person is responsible for informing the RI/FTL and/or the Project Manager immediately in case of a spill considered to represent an emergency even if the spill is not over unpaved soil.

The following information related to any emergency spills will be noted in the field logbook.

- Date and time of spill
- Origin of spill and chemical spilled
- Quantity of spill
- Emergency contacts made (time)
- Completed spill cleanup activities

References and availability of resources

The following references will be maintained in the onsite trailer:

- RI/FS Work Plan including schedule, scope and budget
- SAP (including QAPP / FSP and all attachments)
- Health and Safety Plan including evacuation plan and emergency phone numbers
- MSDSs for the chemicals planned to be used
- Site Management Plan
- HRS Package for the site
- Contacts list including the names and phone numbers of EPA, CH2M HILL and subcontractor personnel
- Subcontractor specifications and terms and conditions
- One 3-ring binder for each form specified in the QAPP / FSP to be used to document the remedial investigation activities (e.g., sampling logbook)
- Visitor logbook
- Drum logbook
- OSHA job site poster

The Health and Safety Plan, MSDSs, evacuation plan, emergency phone numbers, and OSHA poster will be posted at a conspicuous location in the onsite trailer.

Exhibit A-1 Daily Status Report - Diamond Head Oil Site RI/FS	
Field Person Providing Report	
Person Receiving Report	PM RI/FTL
Date and time	Date Time
Boring Nos completed during the day	
Deviations from planned boring /well installation program. Note deviations in: Location Depth Well construction	
Deviations from planned sampling program. Note deviations in: Depth Analyses	
Exceedances of HASP action levels. Note: Activity when it occurred Location where it occurred Worker zone Site perimeter Corrective actions if any	
Problems / Issues encountered	
Assistance needed	
Subcontractor performance / issues	
Any impacts on schedule / budget	
Site visitors and any requests made	
Miscellaneous	

Exhibit A-2
Diamond Head Oil Site RI/FS
Project Contacts

Name	Project responsibility	Location	Phone number				Fax No.	Address
			Office	Ext.	Home	Cell phone		
CH2M HILL Project Team								
Juliana Hess	Project Manager	NJO	973 316 9300	4547	973 9845734			99 Cherry Hill Road Parsippany NJ 07054-1102
Murray Rosenberg	RTL	PHL	215-563-4220				215-563-3828	1700 Market Street, Suite 1600, Philadelphia, PA 19103-3916
Mark Lucas	Senior Technical Geology / Hydrogeology Support	PHL	Same				Same	Same
Andy Judd	RI and Field Team Leader	NJO	973 316 9300	4540			973 334 5847	See above
Pete Walter/Angela Zelman	Property Control Representative	NJO	973 316 9300	4538			973 334 5847	See above
Lalenia Ebert	GIS and database management	WDC						
Paul Arps	Project chemist	MKE	414 272 2426	386				
Chris Hoppfleisher	Field team member	NJO	973 316 9300	4534				See above
John Loeffel	Field team member	NJO						
Jed Campbell	Community Relations Specialist	PHL	215 563 4244	416			215 563 3828	See above
Al Sloan	RAC VI Program Manager	DFW	972 980 2188	205			972 385 0846	5339 Alpha Road Suite 300 Dallas Texas 75240-7352
Kristina Staley	RAC VI Contract Financial Administrative Manager	DFW	972 980 2188	260			972 385 0846	See above
Jane Farnell	RAC VI Administrative Support	DFW	972 980 2188	245			972 385 0846	See above
Dale Foster	Project Controls and Scheduling	DFW	972 980 2188	231			972 385 0846	See above
Nick Fiscina	KA Drilling subcontract	SAN	210 377 3085	246				
Carol Boeschen	KA Labs	DFW	972 980 2188	237				
Leisa Flora	KA Field facilities	ORO	865 483 9005	584				
Val Widgren	KA Field facilities and equipment	ORO	865 483 9005	595				
Hotel								
Onsite Trailer								
EPA Project Team								
Grisell Diaz-Cotto	EPA Remedial Project Manager	NY	212 637 4430				212 637 4429	290 Broadway, 19th floor, New York NY 10007-1866; Diaz-Cotto.Grisell@epamail.epa.gov
John Prince	Section Chief, Central New Jersey Remediation Section	NY	212 637 4380				212 637 4429	290 Broadway, New York NY 10007-1866; Prince.John@epamail.epa.gov

Exhibit A-2
Diamond Head Oil Site RI/FS
Project Contacts

Name	Project responsibility	Location	Phone number				Fax No.	Address
			Office	Ext.	Home	Cell phone		
Sergio Lopez	Sampling and Quality Assurance Support (Primary Contact)	NJ	732??????				732 321-6622	Division of Environmental Science and Assessment Hazardous Waste Support Branch 2890 Woodbridge Ave Edison, NJ 08837-3679; Lopez.Sergio@epamail.epa.gov
Adly Michael	RSCC Assistant	NJ	732-906-6161				See above	See above
Jennifer Feranda	CLP RSCC Coordinator	NJ	732 321-6687.				See above	See above
?????????	Community Relations Specialist	NY						290 Broadway New York NY 10007-1866
Michael Scorca	Geologist/Hydrogeologist	NY	212 637 4316				212 637 3966	290 Broadway New York NY 10007-1866
Michael Clemetson	Environmental Risk Assessment	NY	212 637 6712					290 Broadway, New York NY 10007-1866
Chuck Nace	Human Health Risk Assessment	NY	212 637 4164				212 637 4360	290 Broadway 18th floor New York NY 10007-1866
Subcontractors								
NJ One Call	Utility markeouts to property boundary		1 800 272 1000					
Rettew Associates/Ed Warfel	Survey services		717-394-3721					3020 Columbia Ave Lancaster PA 17603
Enviroscan, Inc./ Felicia Kegel Bechtel	Onsite utility clearance		717 396 8922					1051 Columbia Avenue Lancaster, PA 17603
TO BE DETERMINED	Drilling subcontractor							
TO BE DETERMINED	IDW disposal							
Chemtech/John Gaspari	Lab for all analyses outside CLP		908 789 8900				908 789 8922	284 Sheffield Street Mountainside NJ 07092

Exhibit A-2
Diamond Head Oil Site RI/FS
Project Contacts

Name	Project responsibility	Loca-tion	Phone number				Fax No.	Address
			Office	Ext.	Home	Cell phone		
Vendors/Providers of Support Facilities and Services								
TO BE DETERMINED	Dumpster and tash removal							
TO BE DETERMINED	RI-derived water tank							
TO BE DETERMINED	Clean water tank							
Williams Scotsman/ Sean Miller	Office trainer		631 582 1320				631 582 1251	46 Windsor Pl Central Islip, NY 11722
TO BE DETERMINED	Portable sanitary facility							
TO BE DETERMINED	Electrical and phone lines service connection							
TO BE DETERMINED	Electical service							
TO BE DETERMINED	Phone service							
TO BE DETERMINED	Ice chest and ice supply							
TO BE DETERMINED	Water cooler service							
National Rent a Fence/Annette Ambrossi	Supply of missing fence		1 800 352 5675 or 201 955 3670					2 Fish House Road S Kearny NJ 07032

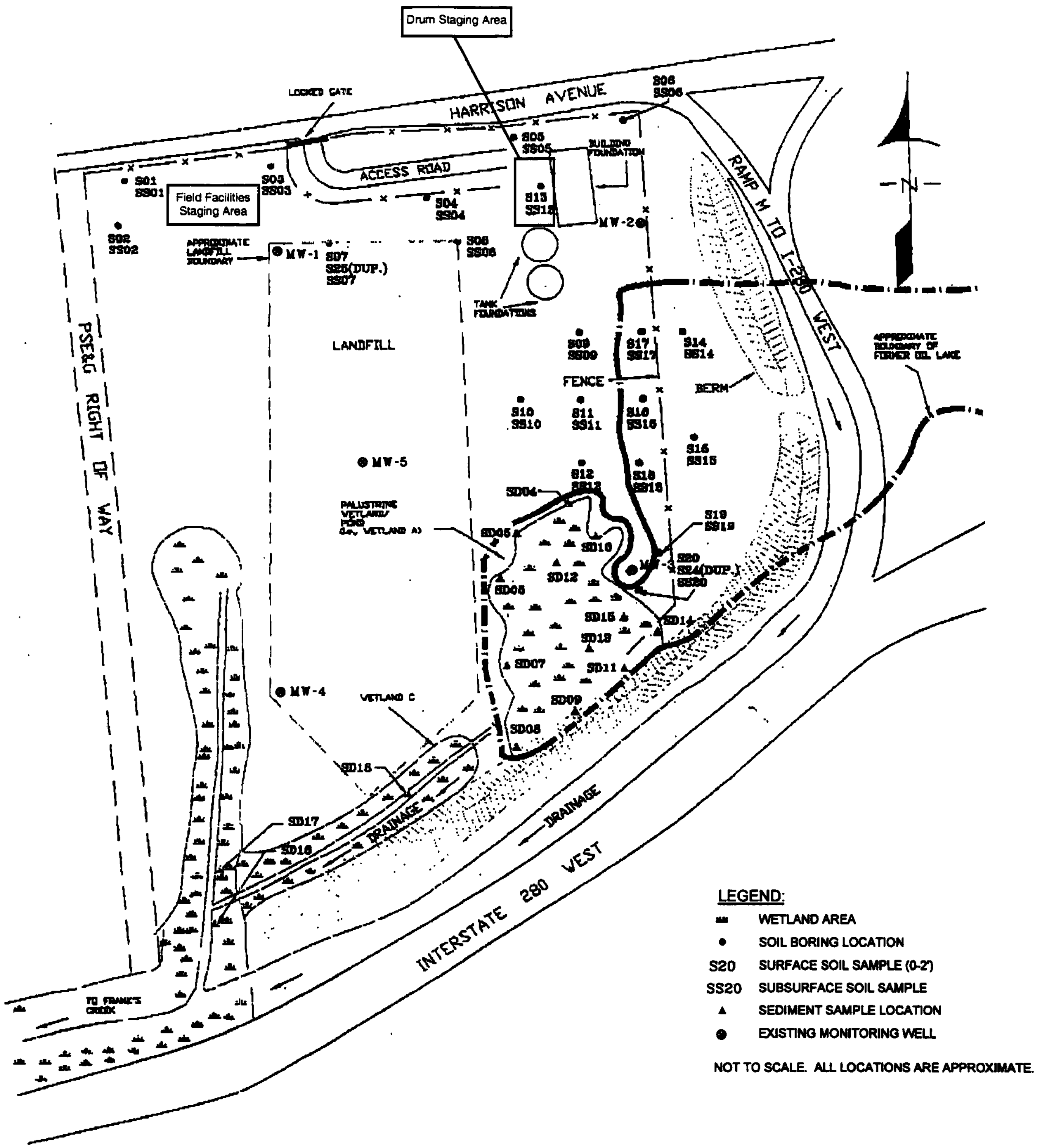


Exhibit A-3
SITE PLAN
Diamond Head Oil RI/FS

Source: Site plan based on plan in 1999 Roy F. Weston ESI

CH2MHILL

Exhibit A-4

Staff Sign-In

Diamond Head Oil Site RI/FS
Kearny, Hudson County, New Jersey, 07032-4310

Work Cycle: **Date:** **CLP Case:**

Name (Print Legibly)	Affiliation	Date	Time Arrived at Site	Time Departed from Site	Purpose of Visit / Comments
Andy Judd	CH2M HILL	4 / 1 / 03	7:00 am	5:00 pm	Soil Investigation

Exhibit A-5

Visitor Sign-In

Diamond Head Oil Site RI/FS
Kearny, Hudson County, New Jersey, 07032-4310

Work Cycle: **Date:** **CLP Case:**

Name (Print Legibly)	Affiliation	Date	Time Arrived at Site	Time Departed from Site	PURPOSE of Visit
Jane Auditer	US EPA	4 / 1 / 03	9:00 am	4:00 pm	Safety Audit

Exhibit A-6
Rental Equipment Tracking Log
Diamond Head Oil Site RI/FS, Kearny, Hudson County, New Jersey, 07032-4310

Equipment Type	Owner	I.D. #	Replaces Unit #	Date Received	Date Returned	Reason Returned
OVM 580B	Pine Environmental	C-1000	Original Unit	01/01/2003	01/31/2003	Dead Battery
OVM 580B	Pine Environmental	C-1001	C-1000	01/31/2003		

Exhibit A-7 Diamond Head Oil Site RI/FS Onsite Management of IDW		
IDW Waste Stream	**Drum Label Abbreviation**	**Onsite Management**
General trash	N/A	Collect in trash dumpster
Cardboard	N/A	Collect in trash dumpster
PPE	PPE	Collect in a drum designated for spent PPE Store drum at the drum storage area on the building foundation Label as required
Decon fluids from sampling equipment	Decon	Collect and store in a drum designated for decon fluids Do not add to storage tank Store drum at the drum storage area on the building foundation Label as required
Decon water from steam cleaning of drill rig	N/A	Collect in the onsite IDW storage tank
Formation water generated during drilling and well development	N/A	Collect in the onsite IDW storage tank
Drill cuttings	Soil	Collect in drums Store drums at the drum storage area on the building foundation Label as required
Incidental spills used cleanup materials	Spill	Collect in a drum designated for used spill supplies Store drum at the drum storage area on the building foundation Label as required

ATTACHMENT B

Standard Operating Procedures

Standard Operating Procedures	
SOP Number	**SOP Topic**
1	Sample Nomenclature
2	Chain Of Custody Procedures
3	Field Logbook Procedures
4	Field Parameter Forms
5	Sample Collection, Bottle, Preservation and Filtration Requirements
6	Sample Labeling, Packaging and Shipping
7	Air Monitoring Equipment (PID, CGI, Aerosol, Draeger Tubes)
8	Horiba U-10/U-22 Multi-Parameter Water Quality Monitoring System
9	Equipment Decontamination
10	Boring Installation Methods and Soil Sampling: RotaSonic Drilling
11	Borehole Abandonment
12	Monitoring Well and Piezometer Design and Construction
13	Monitoring Well and Piezometer Development
14	Water Level, Thickness of Product, and Well-Depth Measurements in Conventional Wells and Piezometers
15	Low Stress (Low Flow) Groundwater Purging and Sampling
16	Subsurface Soil Sampling
17	Collection and Preservation of Soil Samples for VOC
18	LNAPL Shake Test
19	Monitoring for Tidal Influences
20	Surface Water Sampling
21	Sediment Sampling
22	Natural Gamma Borehole Logging

STANDARD OPERATING PROCEDURE
SAMPLE NOMENCLATURE

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for designating sample numbers during the Diamond Head RI. Every sample will have a sample number uniquely identifying the sampling point and phase of sampling.

2.0 Materials

None required.

3.0 Procedure

3.1 Each sample collected during the field investigation will be assigned a unique identification number or alpha-numeric code. The code will provide the information on the following:

- The sample type (SS, SB, MW, PZ, SW, SD, FP, TW, FH, DI, WW, IDW – see table below for definition of each)

FOLLOWED BY

- The sample location as a two digit sequential number - for example 01, 02
- For soil borings at locations where monitoring wells will be constructed – the designation of the well to be constructed at this location (i.e., MW-10S)
- For soil borings at locations where piezomters will be constructed – the designation of the piezometer to be constructed at this location (i.e., PZ-01)
- For samples of free product from monitoring wells – the designation of the well from which the sample is collected (i.e., MW-10S)

FOLLOWED BY

- For soil (surface and subsurface) and sediment samples - the depth at which the sample was collected – The depth will be recorded in two digit numbers. For surface soil and sediment samples, the depth will be in inches below ground surface (bgs) (e.g., 06-12 inches bgs); for subsurface soil samples – the depth will be in feet below the ground surface (e.g., 02-04 feet bgs).
- For groundwater samples from monitoring wells - the type of well (S for Shallow, D for Deep)

FOLLOWED BY

- For all samples – the sampling round number (for this phase – always 1).

Note that samples from the site inspections performed by EPA in 1991 and 1999 will be assigned sample locations first. The investigation phase for these samples will be indicated by 0 followed by the year of the site inspection (e.g., 091 or 099).

For example a sample of the free product in existing shallow well MW-3 collected in 1991, will be marked as follows:

FP- MW-03S-091

The sample collected from this well during the Phase 1 RI, will be marked as follows:

FP- MW-03S-1

The number of sample locations listed below are anticipated to be allocated for the samples collected in 1991 and 1999. Note that these numbers are estimated (i.e., include some contingency) since the data are not available at the time of preparation of this plan in order to count the exact number of sampling locations. If the data are available before the start of the Phase 1 RI, the exact number of sampling locations will be counted and the Phase 1 RI sampling locations will be assigned numbers sequentially from that point on.

Monitoring wells: 1 through 5
Surface soil samples: 10 collected in 1991
Soil borings: 24 collected in 1999
Surface water: 6 collected in 1991
Sediment: total 24 collected in 1991 and 1999

Therefore, the sample location numbers for the Phase 1 RI will begin as follows:

Monitoring wells: 06
Surface soil samples: 11
Piezometers: 01
Soil borings: 25
Surface Water and Sediment: 25 (since both a surface water and a sediment sample will be collected at the same location

The following is a guide for sample identification :

Media	Sample type	Sample location	Sample depth	Sampling round or QC description	Sample number
Surface soil	SS	01-....	Range in inches (00-06 and 06-12)	1991, 1999, Phase 1	---
Example	SS	01	0-6 inches	1991	SS-01-00-06-091
Example	SS	11	0-6 inches	Phase 1	SS-11-00-06-1
Subsurface soil	SB	01-...	Range in feet (varies between locations)	1991, 1999, Phase 1	---
Example 1	SB	01	5-7	1991	SB-01-05-07-091
Example 2	SB	25	12-14	Phase 1	SB-25-12-14-1
Example 3	SB	25	12-14	Phase 1 - Duplicate	SB-25-12-14-D-1
Example 4	SB	PZ-01	12-14	Phase 1	SB-PZ-01-12-14-1
Example 5	SB	MW-06D	5-7	Phase 1	SB-MW-06D-05-07-1
Monitoring well	MW	1-....	S-shallow, D-deep	1991, 1999, Phase 1	---
Example 1	MW	05	S	1991	MW-05S-091
Example 2	MW	10	D	Phase 1	MW-10D-1
Surface water	SW	01-...	NA	1991, 1999, Phase 1	---
Example 1	SW	01	NA	1991	SW-01-091
Example 2	SW	25	NA	Phase 1	SW-25-1
Sediment	SD	01-...	0-6 inches	1991, 1999, Phase 1	---
Example 1	SD	01	0-6 inches	1991	SD-01-00-06-091
Example 2	SD	25	0-6 inches	Phase 1	SD-25-00-06-1
Free Product	FP	MW-06D	NA	Phase 1	---
Example	FP	MW-06D	NA	Phase 1	FP-MW-06S-1
Waste water and solid IDW	WW and IDW	01-....	NA	Phase 1	---
Example	WW	01	Phase 1	Phase 1	WW-01-1
	IDW	01	Phase 1	Phase 1	IDW-01-1

The samples on which the shake test will be performed will be designated using the same nomenclature.

3.2 The QA/QC samples that will be collected and the procedures to follow in assigning sample numbers will be as follows:

D – Duplicate This sample consists of one additional sample volume for each type of analysis collected in separate bottle(s) from the native sample. Duplicate samples will be indicated by a D following the native sample number and will be analyzed for the same parameters as the native sample. For example, the duplicate of sample SB-MW-06S-05-07-1 will be numbered SB-MW-06S-05-07—D-1.

F – Field rinse blank This sample is collected by pouring DI water used for equipment decontamination over a decontaminated piece of equipment. A sample volume is collected for each type of analysis. Field blanks receive a unique sample number and are analyzed for all parameters being sampled for using the particular piece of equipment being decontaminated. Field rinse blanks sample numbers will be indicated by an F followed by:

> The phase of the investigation (091, 099, 1)
> the month
> the date
> a number indicating the sequence of field blanks collected on that day

For example F-1-05-05-02 is the second field blank collected on May 5th during this Phase 1 RI.

T – Trip blank This sample is collected only when aqueous samples for VOC analyses are collected. The trip blank is comprised of two 40 ml vials of DI water for VOC analysis, which are included in every sample cooler containing samples for VOCs analysis. Trip blanks receive a unique sample number and are analyzed for VOCs. Trip blanks sample numbers will be indicated by a T followed by:

> The phase of the investigation (091, 099, 1)
> the month
> the date
> a number indicating the sequence of field blanks collected on that day

For example T-1-05-05-02 is the second trip blank collected on May 5th during this Phase 1 RI.

MS/MSD – Matrix Spike/Matrix Spike Duplicate This sample consists of additional sample volume for each type of analysis collected in separate bottle(s) from the actual sample. MS/MSDs require unique sample designation. The amount of additional volume needed depends on the media being sampled. For soil samples, one additional volume is required; for aqueous samples, two additional volumes are required. MS/MSDs will be indicated by attaching " **– MSD** " at the end of the sample number.

Temperature blanks These samples consist of potable water collected in an unpreserved 40 ml vial and labeled "USEPA Cooler Temperature Indicator". EPA Region II also requires that a temperature blank accompanies each sample shipment. Temperature blanks will be numbered consecutively T1, T2, etc followed by the phase of the investigation. For example, T1-1.

Samples and associated duplicates from the potable tank (TW), fire hydrant (FH), and DI (DI) water produced onsite. These samples will be numbered consecutively as follows: TW01-1 and TW01-1-D, FH01-1 and FH01-1-D, DI01-1 and DI01-1-D

3.3 The Data Management Plan contains an Excel spreadsheet, which will be used to record sample numbers and sample collection information and track the receipt of the results from the laboratories.

3.4 All sample location and identification information will be recorded in the field logbook and other applicable field forms.

3.5 Using the established nomenclature, record the following information on each label in indelible ink:

- Project name;
- Sample location/site ID;
- Sampling date and time;
- Analyses to be performed;
- Preservative; and
- Sampler.

Field personnel will be required to write the sample ID on the samples label.

3.6 Double-check the label information to make sure it is correct. Detach the label, remove the backing and apply the label to the sample container. Cover label with clear tape.

3.7 Record the Sample Number, the CLP sample number, and designated sampling point in the field logbook, along with the following sample information:

- Time of sample collection (each logbook page should be dated).
- The location of the sample.
- Field screening measurements (e.g., PID readings), when appropriate.
- Any unusual or pertinent observations.
- Whether the sample is a QC sample (e.g., field duplicate, blank).

3.8 Place the sample in the designated sample cooler. Make sure there is plenty of ice in the cooler at all times. Maintain the samples at 4□±2□C from the time of sample collection until delivery to the laboratory.

3.9 Provide the copies of the COCs weekly to the Project Manager.

4.0 Maintenance

Not Applicable.

5.0 Precautions

None.

6.0 References

None.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE
CHAIN-OF-CUSTODY PROCEDURES

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the use of the EPA CLP Chain-of-Custody (COC) forms for documenting and tracking organic and inorganic samples. These forms will be completed through the EPA Forms II Lite Software. Refer to the software documentation for specific details on it's application and for examples of the COC forms.

2.0 Materials

1. EPA Forms II Lite Software, Version 5.1 (or latest available version)
2. Laptop computer and laser printer (with printer labels)
3. Indelible black ink pen

3.0 Procedure

3.1 Enter the 5-digit case number provided by EPA's RSCC.

3.2 Give the project name, project code

3.3 Enter CH2M HILL Point of Contact (name and phone number).

3.4 Enter the names of the samplers.

3.5 List the sample number assigned by EPA (from the CLP label), the project- assigned sample number (see the sample nomenclature SOP), and any appropriate QC sample qualifier. Both the CLP sample number and the project-assigned sample number will be entered into the project database. The database can then be queried for strings of characters in the project-specific identifier (e.g., all soil samples from a particular interval in all soil borings, all field rinse blanks, or other).

3.6 Indicate the date of sample collection.

3.7 List the sampling times (24-hour format) for all samples.

3.8 Indicate "grab" or "composite" sample

3.9 Indicate the matrix sampled (e.g., soil, water)

3.10 Identify level of concentration (e.g., low, medium, or high)

3.11 Indicate the analyses per sample location.

3.12 Indicate whether the shipment for the sampling analysis is complete.

3.13 List the preservation requirements for each analysis.

3.14 State the carrier service and air bill number, and analytical laboratory.

3.15 Print the Chain-of-Custody from the Forms II Lite software.

3.16 Sign, date, and time the "relinquished by" section.

3.17 Upon completion of the form, print one Alaboratory copy@ for project records, and print one copy and place inside of the sample cooler to be sent to the designated CLP laboratory.

3.18 Print one copy of the Aregion copy@ for project files and one Aregion copy@ to be faxed to the EPA Sample Manager or RSCC and then sent as a hard copy with the end of sampling case CLP Case Report Summary.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Sample personnel should be aware that a sample is considered to be in a person's custody if the sample is: (a) in a person's actual possession; (b) in view after being in a person's possession; (c) secured for storage such that no one can tamper with it after having been in their physical custody.

6.0 References

None.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE
FIELD LOGBOOK PROCEDURES

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for recording field information in a field logbook.

2.0 Materials

a. Field Logbook
b. Indelible ink pen (normal conditions)
c. Pencil (only for extreme weather conditions – cold/rain)

3.0 Procedure

All information will be recorded in a bound field logbook. The outside front cover of the logbook will contain the project name, location, and the logbook number. The inside front cover will include a mailing address and a point of contact. Each page will be consecutively numbered, dated, and initialed. All entries will be made in indelible ink and all corrections will consist of line-out deletions that are initialed and dated. Pencil will only be used under extreme weather conditions (e.g., freezing temperature, heavy rain) that preclude the use of ink. If only part of a page is used, the remainder of the page should have an "X" drawn across it.

At a minimum, entries in the logbook will include the following:

- Unique, sequential field sample number.
- Time of arrival and departure at the sampling location.
- Sampling rationale.
- Location and description of each sampling point.
- Details of the sample site (e.g., the elevation of the casing, casing diameter and depth, integrity of the casing, etc.)
- Identification of sample crew members.
- Type of sample (e.g., groundwater, soil).
- Number, depth, and volume of sample collected.
- Sampling methodology, including distinction between grab and composite sample.
- Analyses to be performed on the sample.
- Sample preservation.
- Date and time of sample collection.
- QC samples associated with the sample.
- Sample shipment (for example, name of the laboratory and cartage agent - Federal Express, United Parcel Service, etc.)

- Maps of the sampling site.
- Field observations (e.g., weather, description of samples, etc.).
- Field screening measurements (e.g., PID, pH, conductivity).
- Instrument calibration information,
- Description of significant activities for the day
- Notes on visitors to the site,
- Signature and date by the personnel responsible for observations.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory.

Photographs will be taken to document field activities. A log of all photographs taken will be maintained in the field logbook. Disposable cameras will be used with each camera and exposure assigned a sequential number. A log of the photographs taken will be documented on an arbitrary page of the filed logbook. The log will record the following information: camera identification number, exposure identification number (note that for disposable cameras, the frame number will start at 27 and decrease to 1), date and time of each photograph, name of person taking the photograph, and a brief description of the activity photographed. This log will continue until all space on the page is used at which time the log will be transferred to continue on the next available empty page in the logbook. A note will be made at the bottom of the completed page indicating the page number where the log continues. A subsequent note will be placed at the top of the page where the log continues indicating the page number from where it was transferred.

4.0 Maintenance

Not Applicable.

5.0 Precautions

None.

6.0 References

USEPA, 1984. User's Guide to the Contract Laboratory Program.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE FIELD PARAMETER FORMS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to provide the sampling team with a complete set of field parameter forms.

2.0 Materials

a. Field logbook
b. Indelible ink pen
c. Blank forms (printed on all-weather paper)

3.0 Procedure

3.1 Field parameter forms (FPFs) will be used to record various types of field information. Once completed, the original FPF will be filed as part of the project documentation. Each FPF will be filed in a separate field parameter three-ring binder. All entries on FPFs will be made with an indelible ink pen. All corrections will consist of line-out deletions that are initialed and dated.

3.2 Below is a list of the FPFs; which will be used during the investigation:

3.2.1 Sample Tracking Log

1. Log will be used to track samples sent for analyses and receipt of validated results for samples sent for CLP analyses and unvalidated results for samples sent for analyses by subcontracted laboratories outside of the CLP.

2. Complete the log at the end of each day by filling-in the cumulative information for the samples collected during the day.

3. Maintain the log in a 3-ring binder Sample Tracking Logbook.

4. At the end of each week of field activities, provide a copy of the cumulative log to the Project Manager.

3.2.2 Soil Boring Logs; Monitoring Well Completion Diagram; Well Development Log; Low-Flow Groundwater Sampling Field Data Sheet; Water level and LNAPL thickness measurements record

1. Forms will be used to record information at each location.

2. Complete form at each location.

3. File in a designated 3-ring binder at the end of the day.

3.2.3 Shake Test Observation Form and Shake Test Sample Tracking Record

1. Forms will be completed as the shake test is performed on samples in the trailer.

2. File in a designated 3-ring binder at the end of the day.

3.2.4 Daily Equipment Calibration Form and Daily Drilling Activities Summary

1. Reports will be used to document daily equipment calibration and driller activities/progress and other significant activities.

2. Complete log each day.

3. File in a designated 3-ring binder at the end of the day.

3.2.5 Daily Equipment Calibration Record Sheet

1. Form will be used to document required calibration of each field instrument.

2. Complete log each day.

3. File in a designated 3-ring binder at the end of the day.

3.2.6 Field Change Request Form

1. Form will be used to request a change in approved field procedures.

2. Complete form and send to Project Manager prior to implementing change.

3.2.7 Sign-in Forms and Equipment Tracking Log

1. Binders will be established and maintained in the trailer containing these forms.

4.0 Maintenance

Not Applicable.

5.0 Precautions

None.

6.0 References

None.

7.0 Attachments

Sample Tracking Log
Soil Boring Log
Monitoring Well Completion Diagram
Well Development Log
Low-Flow Groundwater Sampling: Field Data Sheet
Daily Activities Summary
Daily Equipment Calibration Record Sheet
Field Change Request Form
Shake tests observation form and shake test samples tracking sheet
Water level and LNAPL thickness measurements record
Site personnel sign-in log
Site visitors sign-in log
Equipment tracking log

ATTACHMENT
FIELD PARAMETER FORMS

E[redacted]

Laboratory Tracking Information for Samples Collected during the Remedial Investigation Activities at the Diamond Head Oil Site
Diamond Head Oil Site RI/FS

Station ID	Sample ID	CLP Sample Number	Duplicate CLP Sample Number	Sample Matrix	Sample Type	Composite Yes or No	Sampling Method	Depth of Sample Top	Depth of Sample Bottom	Units	Sample Date	Sample Time	COC Date	Analyses	Case Number	[illegible]	[illegible]
Subsurface Soil Samples - Borhole Sampling																	
Example																	
SB-25	SB-25-00-02-1	B0EP0/ MB0D54		SO	N	Y	Encore	0	2	ft	11/26/2001	14:10	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-10-12-1	B0EY7/ MB0D48	B0F18/ MB0D49	SO	N	Y	Encore	10	12	ft	11/26/2001	14:26	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-10-12-D-1	B0F18/ MB0D49		SO	FD	Y	Encore	10	12	ft	11/26/2001	14:26	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-20-22-1	B0EZ3/ MB0D50		SO	N	Y	Encore	20	22	ft	11/26/2001	15:40	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-20-22-1	B0EZ3MS/B0EZ3MS		MSD	N	Y	Encore	20	22	ft	11/26/2001	15:40	05/26/2003	TCL VOC, SVOC, pesticides/PCBs	30028		
Groundwater Samples from Monitoring Wells																	
Example																	
MW-5S	MW-5S-1	BOFA6/MBODZ1	BOFA7/MBODZ2	WG	N	N	Centrifugal Pump			ft	07/16/2002	09:40	06/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30707		
MW-5S	MW-5S-D-1	BOFA7/MBODZ2		WG	FD	N	Centrifugal Pump			ft	07/16/2002	09:40	06/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30707		
Surface Water																	
Example																	
SW-25	SW-25-1	BOFA7/MBODZ2		SW	N	N	Hand	NA	NA	NA			07/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30708		
Sediment																	
Example																	
SD-25	SD-25-1	BOFA8/MBODZ3		SD	N	N	Auger	NA	NA	NA			05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30708		
Free Product																	
Waste Water and Solid Waste																	
Potable Tank, Fire Hydrant and De-Ionized Water Samples																	
Equipment and Trip Blanks																	
Example																	
	F-1-05-05-03	B0EN9/ MB0DS9		W	EB	N					11/03/2001	09:55	11/5/2001	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	29935		
	T-1-05-05-03	B0ER0		W	TB	N					11/03/2001	09:50	11/5/2001	TCL VOC	29935		

<u>Legend</u>

SO	Soil sample	N	Normal media sample
MS/MSD	Matrix spike and duplicate	FD	Field duplicate
SL	Sludge sample	EB	Equipment blank
WG	Groundwater sample	TB	Trip blank
SW	Surface water	TCL VOC	Target compound list - volatile organic compounds
SD	Sediment	TCL SVOC	Target compound list - semi volatile organic compounds
FP	Free product	TAL Total Metals	Target analyte list for total metals
WW	Waste water		
IDW	Water sample from sources other than groundwater		
W	Water sample for field and trip blanks		
WZ	Water sample from sources other than groundwater		

CH2MHILL

PROJECT NUMBER	BORING NUMBER
173044.FI.FI.07	SHEET OF

SOIL BORING LOG

PROJECT : Diamond Head Oil Superfund Site LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson C

ELEVATION : DRILLING CONTRACTOF

DRILLING METHOD AND EQUIPMENT USED : Versa Sonic V-100 Sonic Rig, 4" x 10' soil core, 6"/8"/10" override casing

WATER LEVELS : START : END : LOGGER : J. Loeffel

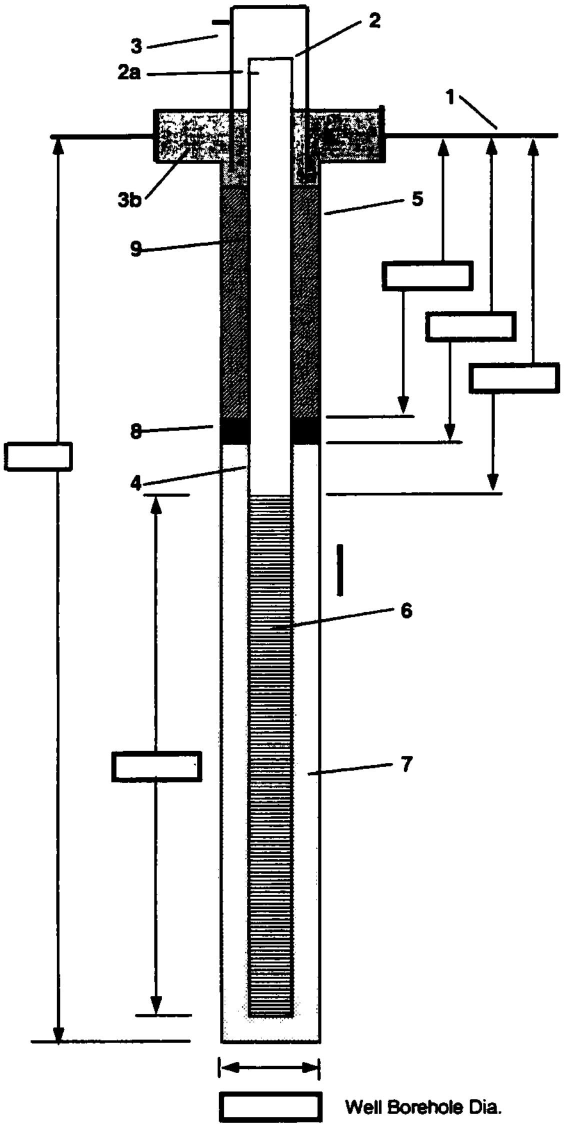
DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID (ppm): Breathing Zone Above Hole

CH2MHILL

PROJECT NUMBER	BORING NUMBER
173044.FI.FI.07	SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT Diamond Head Oil Superfund Site - Phase 1 LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)
ELEVATION : DRILLING CONTRACTOR :
DRILLING METHOD AND EQUIPMENT USED :
WATER LEVELS : START : END : LOGGER :



1- Ground elevation at well

2- Top of Well Casing elevation
a) vent hole?

3- Wellhead protection cover type

b) concrete pad dimensions

4- Diameter/type of well casing

5- Diameter/type of isolation casing NONE

6- Type/slot size of screen

7- Type screen filter
a) Quantity used

8- Type of seal
a) Quantity used

9- Grout
a) Grout mix used
b) Method of placement
c) Quantity of well casing grout

Development method

Development time

Estimated purge volume

Comments

NJDEP Well Permit #

CH2MHILL

PROJECT NUMBER	BORING NUMBER
173044.FI.FI.07	SHEET 1 OF 1

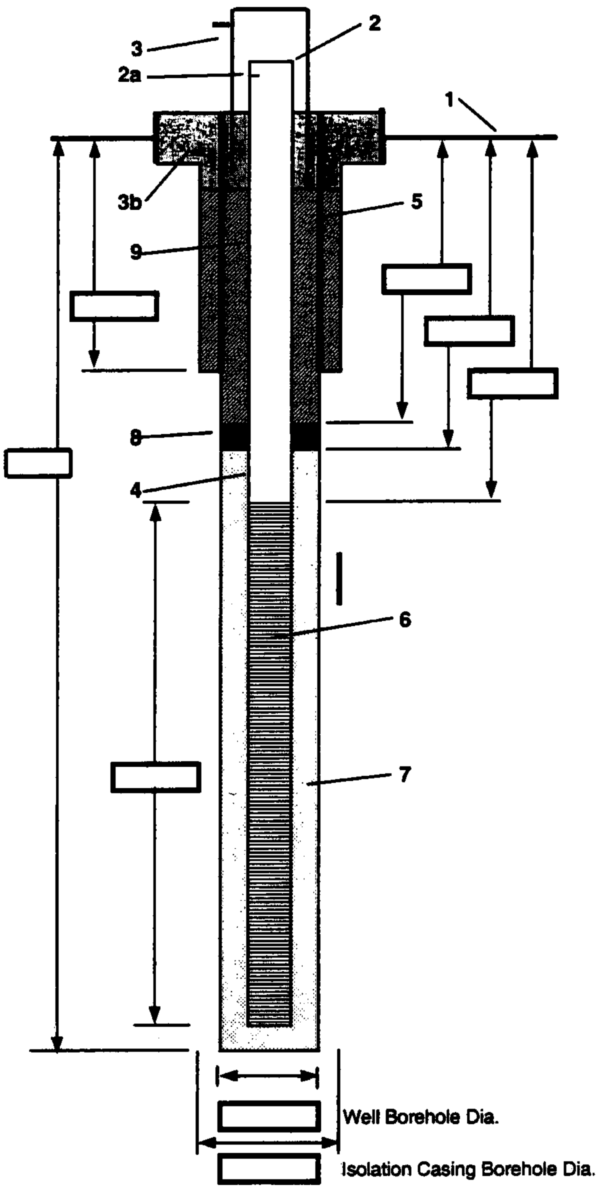
WELL COMPLETION DIAGRAM

PROJECT Diamond Head Oil Superfund Site - Phase 1 LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :



1- Ground elevation at well

2- Top of Well Casing elevation
   a) vent hole?

3- Wellhead protection cover type
   b) concrete pad dimensions

4- Diameter/type of well casing

5- Diameter/type of isolation casing

6- Type/slot size of screen

7- Type screen filter
   a) Quantity used

8- Type of seal
   a) Quantity used

9- Grout
   a) Grout mix used
   b) Method of placement
   c) Quantity of isolation casing grout
   d) Quantity of well casing grout

Development method

Development time

Estimated purge volume

Comments

NJDEP Well Permit #

PROJECT NUMBER	WELL NUMBER
173044.FI.FI.07	SHEET 1 OF 1

CH2MHILL

WELL DEVELOPMENT LOG

PROJECT : Diamond Head Oil Superfund Site LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

Development Contractor:

START Time: END Time : LOGGER :

Diameter of Well (inches) & Type:

Depth of Well (feet):

Depth to Water (feet)

Water Column Height (feet):

Gallons per Foot:

One Well Volume (gallons):

Five Well Volumes (gallons):

Development Method:

Surge Block Used:

Screen Interval Surged:

Water Quality Meter (Manufacturer/Model/Serial #):

Maximum Drawdown During Pumping:

Average Discharge Rate & Range:

Total Quantity of Water Discharged:

Disposition of Discharge Water:

Dia. (in)	Gal./Ft.	Dia. (in)	Gal./Ft.
1"	0.041	5"	1.02
2"	0.163	6"	1.469
3"	0.367	8"	2.611
4"	0.653	10"	4.08

Time	Water Volume Discharged (gal)	Water Level (ft BTIC)	Turbidity (NTU)	Temperature (°C)	pH (Std. Units)	Conductivity (μmhos/cm)	Remarks (color, odor, sheen, sediment, etc.)

Comments:

NJDEP Well Permit # ____________

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number:	**Site:** Diamond Head Oil Superfund Site / 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)
Field Crew:	**Date:** **Project #:** 173044.FI.FI.07

Well Depth (ft.):	Purge Methodology:	Diameter	Gal. Per Foot	Diameter	Gal. Per Foot
DTW (ft.):		2"	.163	5"	1.020
Water Column (ft.):		3"	.367	6"	1.469
Well Diameter (in.):		4"	.653	8"	2.611
Gal. per ft.:	Water Quality Meter:				
Well Volume (gal.):					
Depth of Screen (ft.):					

Field Parameters

	Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
	Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
Initial											
1 VOL.											
2 VOL.											
3 VOL.											
4 VOL.											
5 VOL.											
6 VOL.											
7 VOL.											
8 VOL.											
9 VOL.											
10 VOL.											
Post-Purge											

Remarks: Pump Intake Depth: Control Box Setting (Hz): Development: Sampling:

SAMPLING

Depth to Water Before Sampling:

Sample Methodology: Grunfos 2" RediFlow 2 Submersible Pump with 1/2 inch I.D. Teflon Lined Polyethylene Tubing - Low Flow Rate

Sample Name: QC Sample:

Sample Date/Time:

Sampler / Signature:

Filtered Metals Collected: Y / N Filter Size:

Sample Observations:

Parameters:

SOP 10 - Exhibit 2

DAILY DRILLING ACTIVITY SUMMARY

Project: Diamond Head Oil Superfund Site, 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

Day/Date: **Work Cycle #:** **Lab CASE #** **Project #:** 173044.

Weather:

I. Drilling company:

II. Drilling equipment on site:

A.

B.

C.

D.

E.

F.

III. Drilling personnel on site:

A.

B.

C.

D.

E.

F.

IV. Borings (specify rig & footage for each boring):

A.

B.

C.

D.

E.

V. Coring (specify boring & footage):

A.

B.

C.

D.

E.

VI. Monitoring wells constructed (specify screen interval):

	Well	Total Depth	Screen
A.			
B.			
C.			
D.			
E.			

VII. Development (specify gallons purged):

	Well	Gallons
A.		
B.		
C.		
D.		
E.		

VIII. Comments (standby time, down time, visitors, other site activity, etc.):

____

____

____

____

____

____

Inspected by: ______________________

SOP 7 - EXHIBIT

Diamond Head Oil Superfund Site
1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson County)

DAILY EQUIPMENT CALIBRATION RECORD SHEET

PHOTOIONIZATION DETECTOR (PID)

INSTRUMENT MODEL: ______ MINI RAE 2000 ______ MINI RAE ______ OVM 580B ______ OTHER

RENTAL CO.: ______
MODEL NO.: ______
SERIAL NO.: ______

LAMP TYPE: ______
RF: ______
ALARM: ______

CALIBRATION GAS: Isobutylene CONCENTRATION: ______ LOT NO.: ______ EXP. / Mfg. DATE: ______
REGULATOR: ______ LPM
TUBING CONNECTION: Direct / T-Connection / Tedlar Bag / Other: Calibration Gas Manufacturer: ______

ZERO READING: ______ PPM
CALIBRATION READING: ______ PPM
SOURCE CHECK: ______ PPM

COMMENTS: ______

COMBUSTIBLE GAS INDICATOR (CGI)

RENTAL CO.: ______
INSTRUMENT NAME: ______
MODEL NO.: ______
SERIAL NO.: ______

CALIBRATION GAS: ______ CONCENTRATION: ______ LOT NO.: ______ EXP. / Mfg. DATE: ______
REGULATOR: ______ LPM

OXYGEN READING: ______ % Calibration Gas Manufacturer: ______
LEL READING: ______ %
CO READING: ______ %
H2S READING: ______ %

COMMENTS: ______

Exhibit 10
Field Change Request (FCR) Form

Project Name: Diamond Head Oil Superfund Site ____ **Request Number:** FCR-__________

Field Change Request Title: ______________________________

To: ______________________________

Date: ______________________________

Description:

Reason for Change:

Recommended Disposition

Field Team Leader (or designee): ______________________________
Signature Date

Disposition:

Project Manager: ______________________________
Signature Date

Approval EPA Project Manager: ______________________________
Signature Date

Distribution:
EPA Project Manager
Project QA Officer
CH2M HILL Project Manager
Field Operations Lead
Other:

CH2MHILL

Boring: ____________________

Sample: ____________________

Depth: ____________________

Sample Time: ____________________

Shake Test and Sudan IV Test Observation Form

(For Determination of LNAPL Presence)

Project: Diamond Head Oil, 1401 Harrison Ave, Kearny, NJ 07032-4310 (Hudson Co.)

Date: **Lab CASE #** **Project #:** 173044.FI.FI.07

Soil Description: ____

____

Shake Test Fluid Observations:

Time: **Ended Agitation:** ____________________ **Made Observations:** ____________________

Fluid Clarity (Turbidity): Clear / Translucent (Slightly Turbid) / Opaque (Very Turbid)

Fluid Color: ____

LNAPL Observed: YES / NO / INCONCLUSIVE

Phase Separation: Distinct / Irregular / Intermixed **LNAPL Thickness (mm):** ______________
(< 1mm = Thin Sheen)

LNAPL Color: ____

LNAPL Viscosity: (1=Water, 5=Honey) 1 2 3 4 5

Sudan IV Test Observations

LNAPL Observed: YES / NO / INCONCLUSIVE

Comments: ____

____

Shake Test and Sudan IV Test Sample Tracking Log
Diamond Head Oil Site RI/FS

Station ID	Depth of Sample Top	Depth of Sample Bottom	Sample Date	Sample Time	Time Received at Trailer	Time Analysis Completed	Measured LNAPL Thickness mm	LNAPL Remaining in Soil Pores	Comments
Example									
PZ-01	0	2	11/26/2001	14:10	16:00	17:00	5		
PZ-01	10	12	11/26/2001	14:26	16:00	17:00	4		
PZ-01	20	22	11/26/2001	15:40	16:00	17:00	0	Y	

SOP 14 - Exhibit
Water Levels and LNAPL Product Thickness Measurements

Well ID No.	Date (mm/dd/yyyy)	Time (enter in 24-hr time format; 13:00)	Top of Inner Casing Elevation (feet)	Depth to Top of Product from BTIC (feet)	Depth to Bottom of Product from BTIC (feet)	Depth to Water from BTIC (feet)	Product Thickness (feet)	Water Level Elevation (feet)	Top of Product Elevation (feet)	Depth to Bottom of Well (feet bgs)	Well Bottom Elevation	Well Head PID Readings (ppm)	Comments, Product Description

Exhibit A-4

Staff Sign-In

Diamond Head Oil Site RI/FS
Kearny, Hudson County, New Jersey, 07032-4310

Work Cycle: **Date:** **CLP Case:**

Name (Print Legibly)	Affiliation	Date	Time Arrived at Site	Time Departed from Site	Purpose of Visit / Comments
Andy Judd	CH2M HILL	4 / 1 / 03	7:00 am	5:00 pm	Soil Investigation

Exhibit A-5

Visitor Sign-In

Diamond Head Oil Site RI/FS
Kearny, Hudson County, New Jersey, 07032-4310

Work Cycle: **Date:** **CLP Case:**

Name (Print Legibly)	Affiliation	Date	Time Arrived at Site	Time Departed from Site	PURPOSE of Visit
Jane Auditer	US EPA	4 / 1 / 03	9:00 am	4:00 pm	Safety Audit

Exhibit A-6
Rental Equipment Tracking Log
Diamond Head Oil Site RI/FS, Kearny, Hudson County, New Jersey, 07032-4310

Equipment Type	Owner	I.D. #	Replaces Unit #	Date Received	Date Returned	Reason Returned
OVM 580B	Pine Environmental	C-1000	Original Unit	01/01/2003	01/31/2003	Dead Battery
OVM 580B	Pine Environmental	C-1001	C-1000	01/31/2003		

STANDARD OPERATING PROCEDURE
SAMPLE COLLECTION, BOTTLE, PRESERVATION, AND FILTRATION REQUIREMENTS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for selecting appropriate sample containers and preservation methods for environmental samples collected for chemical analysis.

2.0 Materials

a. Laboratory pre-preserved sample containers
b. In-line cartridge filters (0.45 um)
c. Ice
c. pH paper
d. Safety glasses
e Preservative reagents dispensers

3.0 Procedure

Bottle Requirements

3.1 In general, if the analyte is organic, the container will be made of glass. If the analyte is a metal, then the container will be plastic. Separate samples will be taken when both organic and inorganic analysis are required. Containers will be kept in the dark in coolers (to minimize biological or photooxidation/photolysis breakdown of constituents) until they reach the analytical laboratory. The sample container should allow approximately 10% air space ("ullage") to allow for expansion/vaporization if the sample is heated during transport (1 liter of water at 4°C expands by 15 mL if heated to 130°F/55°C). Headspace is not allowed for sample containers used for VOC analysis.

3.2 Once opened, a container must be used immediately for the storage of a particular sample. Unused, but opened containers are to be considered contaminated and must be discarded; because of the potential for introducing a contaminant, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or missing Teflon liners (if required for that container) are to be discarded.

When sample containers are stored on site, the containers will be stored sealed and as far as possible from the solvents also being stored. Ideally, solvents should be kept in separate facilities from the containers and blank water.

Sample container, sample volume, and sample preservation requirements (for aqueous samples only) are listed in Exhibits 5-1 and 5-2.

3.3 Wet ice will be used to maintain the internal cooler temperature at 4°±2°C.

Preservation Requirements

3.4 Pre-preserved bottles will be used.

3.5 Procedures for chemical preservation of aqueous samples for **VOC analyses** are described below:

1. Samples to be analyzed for VOCs will be preserved by the addition of the correct volume of 1:1 HCl to reduce the pH to less or equal to 2 standard units. Pre-preserved bottles will be used. Visually inspect all vials to ensure that the amount of preservative used is approximately the same.

2. Check the pH of samples collected in pre-preserved bottles at the frequency of once per day. For this purpose, collect an extra sample container for pH determination and test before the actual sample is collected for laboratory analysis. Use a pH meter or pH paper. The pH meter or paper must never be put directly into a sample container collected for laboratory analysis in order to avoid contamination from entering the sample. The pH testing will determine the additional volume (i.e., number of drops), if any, of preservative needed to lower the pH of the sample to less than or equal to 2 standard units.

3. Add the additional number of drops determined to be needed to all VOC samples from a well.

4. Once the need for additional preservative is identified at a location, test the pH of the remaining samples collected at that location. Retest the pH at the next sampling location. As long as the pH does not indicate the need for additional preservative, continue to test the pH at the rate of once per day.

5. Add any additional preservative determined to be needed in the field, to the sample bottle from a dispenser container before the sample is added to the bottle.

6. Following sample collection in the pre-preserved bottle, cap and gently agitate the sample bottle in order to homogenize the preservative throughout the sample and to ensure that no air bubbles are present.

7. If air bubbles are present, discard the sample container and prepare a new container.

8. Failure to chemically preserve the aqueous VOC sample fraction will reduce the holding time to 7 days.

3.6 Procedures for chemical preservation of aqueous samples for **non-VOC** analyses are described below:

1. Pre-preserved bottles will be used.

2. Check the pH of samples collected in pre-preserved bottles at the frequency of once per day. For this purpose, collect an extra sample container for pH determination and test before the actual sample is collected for laboratory analysis. Use a pH meter or pH paper. The pH meter or paper must never be put directly into a sample bottle collected for laboratory analysis in order to avoid contamination from entering the sample. The pH testing will determine the additional volume (i.e., number of drops), if any, of preservative needed to lower the pH of the sample to less than or equal to 2 standard units.

3. Add the additional number of drops determined to be needed to all samples collected from a well.

4. Once the need for additional preservative is identified at a location, test the pH of the remaining samples collected at that location. Retest the pH at the next sampling location. As long as the pH does not indicate the need for additional preservative, continue to test the pH at the rate of once per day.

5. Any additional preservative determined to be needed in the field, will be added to the sample bottle from a dispenser container before the sample is added to the bottle.

6. Following collection of the sample in the pre-preserved bottle, the bottle will be capped and gently agitated in order to homogenize the preservative throughout the sample.

Note: If acidification causes effervescence, the sample should be submitted without preservation except for cooling to 4o±2oC. The effervescence should be noted in the field logbook and the Chain-of-Custody form.

Sample Collection Procedures

3.7 Groundwater samples will be collected in the order of decreasing compound volatility. Field indicator parameters will be collected through an in-line flow-through cell while the well is being purged. Upon stabilization of the indicator parameters, the flow-through cell will be disconnected and groundwater samples collected directly from the pump discharge tubing. The groundwater samples will be collected in the following order: TCL VOCs followed by all other organics on the TCL list (SVOC, Pesticides, PCBs), TAL metals (total), TAL metals (dissolved).

3.8 Samples for TCL VOC analyses must be collected by filling the sample vials in a manner that will minimize water agitation and therefore, loss of VOCs during sampling. Fill the vial slowly until the water forms a positive meniscus at the brim. Replace the cap by gently setting it on the water meniscus. Tighten firmly, invert the vial, and tap it lightly. If air bubbles are present in the sample, use another vial to collect another sample. Place samples in a cooler with sufficient bagged ice to cool the samples to 4oC immediately upon collection.

3.9 Proceed with filling the bottles for the remaining TCL organics and TAL total metals analyses. Note that the presence of headspace – while undesirable – does not require re-sampling as with the VOC vials.

3.10 Filtering

A. Low Turbidity Groundwater

- Groundwater samples for dissolved metals analyses will be filtered using disposable In-Line Filter Cartridges with a 0.45 um sieve.
- Connect the filter cartridge directly to the discharge tubing from the pump.
- Collect sample from the filter discharge nozzle.
- Dispose of in-line cartridge.

B. High Turbidity Groundwater

- A sample of raw groundwater with high turbidity may be collected into an unpreserved, 1 liter HDPE bottle.
- Allow the bottle to stand, undisturbed, for approximately 5 minutes to allow the entrained sediment to settle to the bottom of the bottle.

- Using a peristaltic pump with dedicated silicone tubing with a filter attached to the end, skim the raw water from the bottle into an appropriately preserved bottle for TAL metals analysis.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Fill vials for VOC analyses slowly and check for bubbles.
Ensure that the discharge tubing is connected to the correct end of the in-line filter as indicated by the embossed arrow
Personnel should wear the appropriate personal protective equipment when handling preservatives and environmental samples.

6.0 References

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater. 15th Edition. APHA, Washington, DC.
USEPA, 1989. Region II CERCLA Quality Assurance Manual. Oct. 1989.
USEPA, 1984. Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act. Federal Register, Vol. 49 (209), Oct. 26, 1984, p. 43234.
USEPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. USEPA-EMSL, Cincinnati, OH.

7.0 Attachments

Exhibit 1 to this SOP summarizes the analytical program including sample bottle, preservation, and holding time requirements.

Summary of Analytical Program
Diamond Head RI/FS

Media sampled	Analyses	Analytical Method	Laboratory performing analysis	Type of bottles	Number of bottles per sample	Preservation	Amount of Preservative	Sample Holding Time
Soil and Sediment	VOCs	OLM04.2	CLP	EnCore samplers	3	4°C	-	48 hours
				2 oz clear glass wide mouth jar	1	4°C	-	
	semi-VOCs	OLM04.2	CLP	8 oz amber glass wide mouth jar	1	4°C	-	14 days to extraction then 40 days from extraction to analysis
	pesticides and PCBs	OLM04.2	CLP	8 oz clear glass wide mouth jar	1	4°C	-	14 days to extraction then 40 days from extraction to analysis
	metals	ILM04.1	CLP	8 oz clear glass wide mouth jar	1	4°C	-	6 months
Soil	TOC	SW-846 9060	Subcontracted lab	8 oz glass jar	1	4°C	-	28 days
	pH	SW-846 9045C	Subcontracted lab	4 oz. glass jar	1	4°C	-	NR
	Grain size	ASTM D422-63	Subcontracted lab	16 oz. glass jar	1	NR	-	NR
	Bulk density	ASTM D698-00	Subcontracted lab	4 oz. glass jar	1	NR	-	NR
Groundwater and Surface Water	VOCs	OLC03.2	CLP	40 ml vials	3	HCL to pH<2, 4oC	0.5 mL	14 days
	semi-VOCs	OLC02.0	CLP	1l amber glass Boston round jar	2	4°C	-	7 days to extraction and 40 days from extraction to analysis
	pesticides and PCBs	OLC02.0	CLP	1l amber glass Boston round jar	2	4°C	-	7 days to extraction and 40 days from extraction to analysis
	metals (total or dissolved)	ILM04.1	CLP	500 ml poly narrow mouth	1	HNO3 to pH <2, 4oC	3 mL	6 months
Groundwater	Alkalinity	EPA 310.1	Subcontracted lab	250 ml polyethylene	1	4°C	-	14 days
	TSS	EPA 160.2	Subcontracted lab	500 ml Polyethylene	1	4°C	-	7 days
	TDS	EPA 160.1	Subcontracted lab	500 ml polyethylene	1	4°C	-	7 days
	Hardness	EPA 130.2	Subcontracted lab	250 ml polyethylene	1	H_2SO_4 to pH <2, 4°C	0.3 mL	6 months
	Ferrous iron	SM 3500-FE D	Subcontracted lab	100 ml polyethylene	1	4°C	-	Upon receipt by laboratory
	Ammonia	EPA 350.1	Subcontracted lab	250 ml Polyethylene	1	H_2SO_4 to pH <2, 4°C	1 mL	28 days
	TKN	EPA 351.2	Subcontracted lab	500 ml Polyethylene	1	H_2SO_4 to pH <2, 4°C	1 mL	28 days
	Nitrate	EPA 353.2	Subcontracted lab	100 ml polyethylene	1	4°C	-	48 hours
	Nitrite	EPA 354.1	Subcontracted lab	100 ml polyethylene	1	4°C	-	48 hours
	Phosphorous, Total	EPA 365.3	Subcontracted lab	100 ml Polyethylene	1	H_2SO_4 to pH <2, 4°C	0.5 mL	28 days
	Chloride	EPA 325.2	Subcontracted lab	100 ml Polyethylene	1	4°C	-	28 days
	Sulfate	EPA 375.2	Subcontracted lab	100 ml Polyethylene	1	4°C	-	28 days
	Sulfide	EPA 376.1	Subcontracted lab	250 ml Polyethylene	1	4°C, Zn acetate, NaOH to pH>9	1.5 mL NaOH + 2 mL Zn acetate	7 days
	Methane	8015B or RSK 175	Subcontracted lab	40 mL glass vials	3	4°C	-	14 days
	Ethane	8015B or RSK 175	Subcontracted lab	40 mL glass vials	3	4°C	-	14 days
	Ethene	8015B or RSK 175	Subcontracted lab	40 mL glass vials	3	4°C	-	14 days
	TOC	SW-846 9060	Subcontracted lab	100 ml polyethylene	1	H2SO4 to pH<2, 4°C	0.3 mL	28 days
	BOD	EPA 405.1	Subcontracted lab	1 L Polyethelene	1	4°C	-	48 hours
	COD	EPA 410.1	Subcontracted lab	100 ml polyethylene	1	H_2SO_4 to pH <2, 4°C	0.3 mL	28 days
	CO2	SM 4500-CO2D	Subcontracted lab	40 mL glass vials	1	4°C	-	14 days
LNAPL	TCL-VOCs	8260	Subcontracted lab	40 ml vials	3	cool to 4°C	-	48 hours
	TCL-semi-VOCs	8270	Subcontracted lab	8 oz glass	1	cool to 4°C	-	14 days to extraction then 40 days from extraction to analysis

SOP 5 - Exhibit
Summary of Analytical Program
Diamond Head RI/FS

Media sampled	Analyses	Analytical Method	Laboratory performing analysis	Type of bottles	Number of bottles per sample	Preservation	Amount of Preservative	Sample Holding Time
	TCL-pesticides/ PCBs	8081	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	14 days to extraction then 4(days from extraction to analysis
	TAL-metals	8260	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	6 months
	GRO & DRO	8015	Subcontracted lab	8 oz clear glass	2	cool to 4°C	-	14 days
	Haz waste characteristics - Ignitability	1010	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	14 days
	Haz waste characteristics - corrosivity	9045	Subcontracted lab					
	Haz waste characteristics - reactivity	7.3.3.2	Subcontracted lab					
	Full TCLP	1311/8000/6000	Subcontracted lab	8 oz clear glass	3	cool to 4°C	-	14 days
	Specific gravity	2710	Subcontracted lab					
Investigation Derived Waste (solid)	Haz waste characteristics - Ignitability	1010	Subcontracted lab	8 oz clear glass	1	cool to 4°C	-	14 days
	Haz waste characteristics - corrosivity	9045	Subcontracted lab					
	Haz waste characteristics - reactivity	7.3.3.2	Subcontracted lab					
	Full TCLP	1311/8000/6000	Subcontracted lab	8 oz clear glass	3	cool to 4°C	-	14 days

Pre-preserved bottles will be used for all samples requiring chemical preservation.

Sample bottles for analyses subcontracted outside of CLP, will be provided by the laboratories selected to perform the analyses.

Field QA/QC samples will be collected as follows:

Duplicate samples - 1/10 or a minimum of one per week. Collect weekly duplicate at the start of the week and each time after that, that 10 samples have been collected. Duplicates are two discrete samples collected at the same location.

Additional volume for MS/MSD samples - Collect 1 additional sample volume for soil and two additional sample volumes for groundwater. Frequency is 1/20 or a minimum of one per week. Duplicate samples and MS/MSD samples should not be collected from the same sampling location. Collect MS/MSD at the start of the week and each time after that, that 20 samples have

Trip blanks: Trip blanks must accompany each shipment of aqueous samples for VOC analyses. Trip blanks are collected using two 40-ml VOC vials.

Field blanks: 1/each decontamination event per type of sampling equipment not to exceed one per day. Field blanks are collected using the same types of bottles as the groundwater

Temperature blanks: A temperature blank must accompany each sample shipment. The temperature blank consists of one unpreserved 40 ml vial.

H2SO4 used is concentrated. HCL and HNO3 are diluted 1:1 by volume.

STANDARD OPERATING PROCEDURE
SAMPLE LABELING, PACKAGING AND SHIPPING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe protocols for the labeling, packaging and shipping of samples to the laboratory for analysis.

2.0 Materials

a. Waterproof hard plastic coolers
b. Metal paint cans
c. Sample labels from subcontracted laboratories, CLP labels, custody seals
d. Chain of custody forms from subcontracted laboratories and Form II Lite software to prepare chain of custody forms for the CLP laboratories
d. Absorbent packing material
e. Ice
f. Clear tape
g. Clear ziploc bags

3.0 Procedure

3.1 Place each sample in the shipping cooler as collected.

3.2 Ensure sample lids are tight.

3.3 Place the following, properly filled-out, on each sample bottle:

CLP sample label <u>OR</u> Subcontracted laboratory sample label

3.4 Place Custody Seal across the cap of each bottle.

3.5 Enclose each sample, properly identified and with a sealed lid, in a clear Ziploc bag, and make sure that sample labels are visible.

3.6 Bag and seal loose ice in ziploc bags to prevent melting ice from soaking the packing material. Place sufficient ice in cooler to maintain the internal temperature at $4\pm2^{\circ}C$ during transport.

3.7 Fill cooler with enough absorbent and packing material to prevent breakage of the sample bottles and to absorb the entire volume of the liquid being shipped (off site sample shipment only).

3.8 Any samples suspected to be of medium/high concentration must be enclosed in a metal can with a sealable lid (e.g., paint cans). The samples should be cushioned inside the can with enough noncombustible, absorbent material (e.g., vermiculite) to prevent breakage and absorb leakage. Label the outer metal container with the sample number of the sample inside.

3.9 Affix the Chain of Custody form to the underside of the cooler lid. If more than one cooler is being used, a unique COC must be completed for each cooler and the samples contained therein.

3.10 Seal coolers at a minimum of two locations (e.g., opposite corners of the cooler) with signed custody seals and cover the seals with clear tape.

3.11 Tape the cooler shut with strapping tape over the hinges and place tape over the cooler drain. Do not obscure the custody seals.

3.12 Attach completed shipping label to the top of the cooler using wide clear tape.

3.13 Ship all samples via priority overnight delivery within 24 hours of collection (off site sample analyses only) or transport in cooler to on-site laboratory for analysis. Insure all sample shipments up to $1,000.

4.0 Maintenance

Not Applicable.

5.0 Precautions

None.

6.0 References

USEPA. 1990. Sampler's Guide to the Contract Laboratory Program. EPA/540/P-90/006, Directive 9240.0-06, Office of Emergency and Remedial Response, Washington, D.C., December 1990.

USEPA. 1991. User's Guide to the Contract Laboratory Program. EPA/540/O-91/002, Directive 9240.0-01D, Office of Emergency and Remedial Response, January 1991.

7.0 Attachments

None

STANDARD OPERATING PROCEDURE
AIR MONITORING EQUIPMENT (PID, CGI, AEROSOL, DRAEGER TUBES)

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to generally describe the protocol for using an assortment of air monitoring instruments that will be used to evaluate environmental conditions and monitor for health and safety considerations. The instruments that will be used during the Remedial Invesigation include Photoionization Devices (PID), Combustible Gas Indicators (CGI), Aerosol monitors (for airborne dust particulates), and Drager Tubes for determining vinyl chloride in ambient air. The following SOP provides a general introduction to the equipment and should be supplemented by referencing the equipment-specific operation and maintenance manuals provided by the manufacturer.

2.0 Materials

a. Specific piece of monitoring equipment
b. Associated calibration equipment
c. Power supply equipment (e.g., batteries or charging cords)
d. Manufacturer's equipment specific operation and maintenance manual

3.0 Procedure

3.1 The attached "HS&E Field Equipment Manual" produced by CH2M HILL's health and safety department provides an overview of the operation and maintenance of PID and CGI air monitoring equipment. This document should be reviewed in conjunction with the equipment-specific operation and maintenance manuals provided by the manufacturer. Additionally, CH2M HILL's site-specific Health and Safety Plan should be consulted for specific air monitoring requirements, calibration requirements, and action levels established for the Diamond Head Oil site.

4.0 Maintenance

As precribed by the equipment manufacturer.

5.0 Precautions

Avoid skin contact with calibration fluids.

6.0 References

Equipment Specific Operations and Maintenance Manuals
CH2M HILL's "HS&E Field Equipment Manual"
CH2M HILL's site-specific Health and Safety Plan for the Diamond Head Oil Site

7.0 Attachments

Equipment Calibration Form
CH2M HILL's "HS&E Field Equipment Manual"

SOP 7 - EXHIBIT

Diamond Head Oil Superfund Site

1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson County)

DAILY EQUIPMENT CALIBRATION RECORD SHEET

EMPLOYEE: ______________________ LOCATION: ______________________

DATE: ______________________ PROJECT NO.: 173044.FI.FI.07

WEATHER: ______________________

HORIBA U-22

RENTAL CO.: ______________________ CALIBRATION SOLUTION MFR.: ______________________

MODEL NO.: U-22 CALIBRATION SOLUTION LOT NO.: ______________________

SERIAL NO.: ______________________ CALIBRATION SOLUTION EXP. / MFG. DATE: ______________________

CALIBRATION PROCEDURE: AutoCalibrate

pH:	Reading		Units	Std. Units	Standard	4.0 Std. Units
Conductivity	Reading		Units		Standard	4.49 mS/cm
Turbidity:	Reading		Units	NTU	Standard	0.0 NTU
Temperature:	Reading		Units	°C	Standard	N/A
Dissolved Oxygen:	Reading		Units	mg/L	Standard	20.9 mg/L (Ambient Air)
ORP:	Reading		Units	mV	Standard	N/A

COMMENTS: ______________________

CALIBRATION OK: Y / N

HORIBA U-10

RENTAL CO.: ______________________ CALIBRATION SOLUTION LOT NO.: ______________________

MODEL NO.: U-10 CALIBRATION SOLUTION EXPIRATION DATE: ______________________

SERIAL NO.: ______________________ CALIBRATION SOLUTION EXP. / MFG. DATE: ______________________

CALIBRATION PROCEDURE: AutoCalibrate

pH:	Reading		Units	Std. Units	Standard	4.0 Std. Units
Conductivity	Reading		Units		Standard	4.49 mS/cm
Turbidity:	Reading		Units	NTU	Standard	0.0 NTU
Temperature:	Reading		Units	°C	Standard	N/A
Dissolved Oxygen:	Reading		Units	mg/L	Standard	20.9 mg/l (Ambient Air)

COMMENTS: ______________________

CALIBRATION OK: Y / N

HS&E Field Equipment Manual

CH2MHILL

Contents

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**Note: Each direct reading instrument will address operation, calibration, and limitations.*

Direct-Reading Instruments

Airborne contaminants can present a significant threat to worker health and safety. Reliable measurements of airborne contaminants are useful for:

- Assessing the potential health effects of exposure
- Selecting personal protective equipment
- Delineating areas where protection is needed and protective work zones
- Determining the need for specific medical monitoring
- Determining the most appropriate equipment for additional monitoring
- Developing optimum sampling and analytical protocols

The two principal methods of evaluating air contaminants are direct-reading instruments and the laboratory analysis of collected air samples.

Direct-reading instruments, also known as real-time monitors, are tools for detecting and quantifying gases, vapors, and aerosols. The monitors are referred to as "direct' or "real-time" because they permit instantaneous or nearly immediate results. Air contaminants are sampled and analyzed within the instrument in a relatively short time. Each machine performs either active or passive sampling and measurement. Active sampling involves the collection of airborne contaminants via a forced movement of air such as an air pump. Passive sampling is the collection of airborne contaminants at a rate controlled by a physical process such as diffusion through a static layer or permeation through a membrane without the forced movement of air.

Direct-reading instruments may be used to rapidly detect flammable or explosive atmospheres; oxygen deficiency; and certain gases and vapors; and dust concentrations. Priorities for air monitoring shall be based on:

- *Monitoring for Immediately Dangerous to Life of Health (IDLH) conditions*

  Air monitoring for IDLH atmospheres includes identifying conditions such as flammable or explosive atmospheres, oxygen-deficient environments, and highly toxic levels of airborne contaminants.
- *Exposure monitoring*

  Exposure monitoring includes the characterization of chemical or physical agents to determine the type and extent of exposure. By comparing the data to occupational exposure limits or action levels, the worker protection plan can be developed.
- *Perimeter monitoring*

  Perimeter monitoring measures the extent of contaminant migration away from the site or project area. These results help identify exclusion zone boundaries and any public health concerns. Perimeter monitoring will also measure airborne contaminant concentration from changes due to atmospheric conditions, work location, types of contaminants, or types of operation

Direct-reading instruments range in size from small personal monitors to hand-held devices to large, complex installations. Most instruments indicate results through a digital or analog display. The measurement can be as specific as a single gas or vapor, certain categories of gases and vapors, or as non-specific as multiple gases and vapors. The health and safety coordinator will follow the instructions contained in the site written safety plan, which will specify collecting samples in the breathing zone or general work area. The results can be reported as an instantaneous concentration or a time-weighted average. A variety of detection processes are used for gases and vapors including infrared (IR), ultraviolet (UV), flame ionization, photoionization, colorimetric, and electrochemical reaction. Direct-reading instruments for aerosols operate using optical, electrical, resonance oscillation, and beta absorption.

Operators need to be familiar with the instrument's operating procedures and limitations. Refer to the instrument's operator's manual for specific information concerning the instruments operation, calibration, and troubleshooting.

Advantages:

- Perform both sampling and measurement; ideal for immediate data.
- Eliminate lag time for lab to analyze samples.
- Data-logging capabilities free the safety coordinator of manually recording data and allow for statistical analysis and graphic presentation.
- Field monitoring instruments are usually lightweight, portable, rugged, temperature sensitive, and simple to operate and maintain.

Disadvantages:

- There is no single instrument that can measure all contaminants in the air.
- Instruments used for gases and vapors cannot be used for measuring aerosols.
- In general, direct-reading instruments for aerosols cannot differentiate between types of aerosols.
- Instrument performance and accuracy can be directly affected by environmental conditions.
- Interferences with similar compounds, resulting in false readings.
- Calibrated using single standard and not for each gas, vapor, or aerosol measured.
- Usually do not detect airborne concentration below 1 part per million (ppm).

Photoionization Detectors (PID)

The PID is a nonspecific survey instrument used to give qualitative information on the concentration and class of chemicals present in the air. The PID operates on the fact that most organic compounds and some inorganic compounds can be ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecule and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called ionization potential (IP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized, for each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air it is possible to use PIDs quantitatively. Chemical structure and lamp intensity both affect the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibrant gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory calibrant zero gas should be used.

Advantages

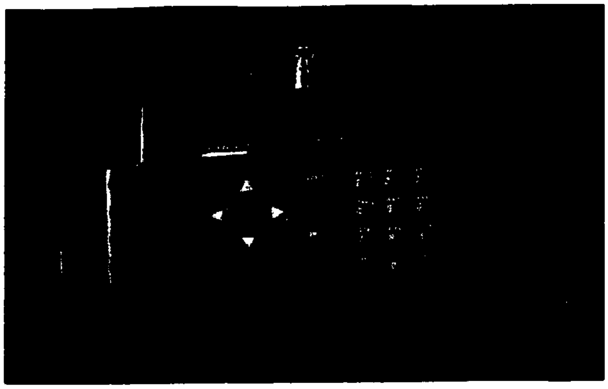
- The ionization potential of atmospheric gases (nitrogen, oxygen, water, carbon monoxide, and carbon dioxide) and methane is greater than 12 eV, so measurements of contaminants in ambient air will not be affected by these components.
- Can detect some inorganic compounds.
- Many PID models have data-logging capabilities and data retrieval options.
- Smaller, lighter models are being manufactured; one model can be mounted in a worker's breathing zone.
- Does not require carrier gases or fuel gases (hydrogen used in FIDs).

Disadvantages

- The PID does not distinguish between chemicals.
- 11.7 eV and 11.8 eV lamps have short usable lives due to window degradation caused by the effects of UV on the hygroscopic lithium fluoride.
- Humidity, particulates, and hot and corrosive atmospheres adversely affect the PID.

- Water vapor can cause lamp fogging and deflect, scatter, or absorb light causing less light to reach contaminant for ionization and lower meter readings.

TVA 1000



Calibration Check

Ready Instrument

- Check that the instrument was charged overnight.

Start Up Instrument

1. Press the ON button and verify that the instrument completes the self-diagnostic test, which takes approximately 15 seconds.

- To turn on pump, press "CONTROL".

Calibration Check and Adjustment

2. Press "2" and then press "1".
3. Press "2" to zero to ambient air. When the calibration is complete, the display will briefly display "ACCEPTED".
4. To select the gas concentration of the calibration gas, press "4".
5. To change the concentration to a new value, press "2".
6. Use the up and down keys to select %, ppm, ppb, and decimal point position. Then type the numerical value for the concentration. Press "ENTER" to store the value and press "EXIT" to return to the calibration menu.
7. From the calibration menu, set the span to 1.00 by pressing "5".
8. Use the up and down keys to select %, ppm, ppb, and decimal point position. Then type the numerical value for the concentration. Press "ENTER" to store the value and press "EXIT" to return to the calibration menu.
9. From the calibration menu, set the response factor to 1.00 by pressing "5".
10. To change the response factor to a new value, press "2".
11. Type "1.00" and press "ENTER" to store the value.
12. Press "EXIT" to return to the calibration menu.
13. Calibrate the instrument by pressing "3" and then "2".
14. Connect the span gas and then press "ENTER". When the calibration is complete, the display will briefly read "ACCEPTED".
15. Reset the response factor to 1.32 so that the TVA 1000 mimics the HNu by pressing "5".

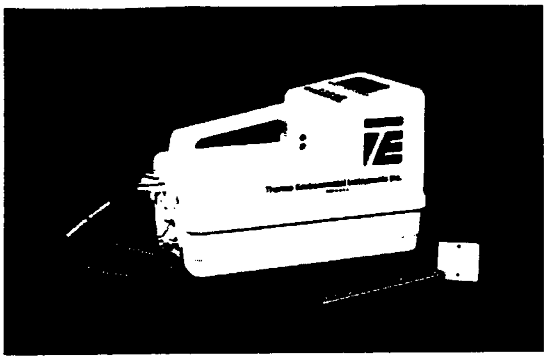
16. To change the response factor to a new value, press "2".
17. Type "1.32" and press "ENTER" to store the value.
18. Press "EXIT" twice to return to the main menu.
19. To take a measurement, press "1".
20. Calibration is complete

Troubleshooting

When the analyzer is operating, dust or other foreign matter could be drawn into the probe, forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. The probe filter should be used and cleaned after use in moist or dusty conditions. Check for this condition monthly or as required. Detailed instructions are in the Handout.

- For a low battery, recharge the instrument.
- Drifting readings can mean that the lamp is dirty and needs to be cleaned.
- Humidity can cause false readings.
- High methane concentrations can result in false low readings of the PID.

OVM Datalogger



Calibration Check

Ready Instrument

1. Check to see what lamp is in the instrument.

2. Power-up instrument by plugging in the power plug or the charger cable.

Start Up Instrument

1. Press "ON/OFF" key to ignite lamp and initiate sample pump. The words "LAMP OUT"
will be displayed until lamp is ignited. Unit is then operational.

Setting Zero

1. Press "MODE/STORE" key.
2. Using "-/CRSR" key, scroll through: "LOG THIS VALUE"-- "R/COMM"-- "CONC METER"-- "FREE SPACE"-- "RESET TO CALIBRATE." Display should read "RF=1.00".
3. If RF needs to be changed, hold down "RESET" while pressing "-/CRSR" to select cursor position. Then use "+/INC" key to set response factor (RF) to "1.00". Release RESET key only when selection is made.
4. Using "-/CRSR" key, scroll to "LAMP." Verify LAMP setting: If the setting needs to be changed, press "RESET", press "+/INC" for 10.0 EV LAMP. Press
"-/CRSR" for 11.8 EV LAMP. Press "RESET".
5. Using "-/CRSR" key, scroll through "LAMP"-- "ALM"-- "AVERAGE"-- "LOC. CODE MODE"-- "AUTO LOGGING"-- "CONC METER"-- "FREE SPACE". Display should read "RESET TO CALIBRATE". Press "RESET" key.
6. Press "-/CRSR" in response to "RESTORE BACKUP" prompt.
7. Press "RESET" key. Instrument will zero to ambient air. (Note: Zero gas or a zero filter may be used to set the unit to an absolute zero -- connect prior to pressing "RESET" key.)

Calibration Check and Adjustment

1. Instrument should display "SPAN PPM = --- + TO CONTINUE".
2. Press "RESET" and "-/CRSR" keys simultaneously to select cursor position.
3. Press "RESET" and "+/INC" keys simultaneously to scroll through

preset SPAN values. Set SPAN = 100, which corresponds to the 100 ppm isobutylene.

4. When span has been entered, press "+/INC" key to continue.
5. Connect span gas cylinder. Turn valve on. Press "RESET" key.
6. When finished calibrating, display will read "RESET TO CALIBRATE". Press "MODE/STORE" key. Display should read about 100 ppm. Turn valve off. Disconnect span gas cylinder.
7. Calibration complete

Troubleshooting

When the analyzer is operating, dust or other foreign matter could be drawn into the probe, forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. The dust prefilter should be replaced as needed.

- If the battery is low, recharge the instrument.
- Drifting readings can mean that the lamp is dirty and needs to be cleaned.
- Humidity can cause false readings.
- High methane concentrations can result in false low readings.

Mini RAE

Calibration Check

Ready Instrument

- Check that the instrument was charged overnight.

Start Up Instrument

- Press the ON button.
- Observe "HG-1.31" on display, and observe pump startup. The display should now read "0.0". (This display can vary depending on model.)

Calibration Check and Adjustment

1. Press the MENU button to begin scrolling through the menu items. The display should read "Pd-0000", prompting the user for a password.
2. Press the ENTER button (four times) to accept "0000" as the password. DO NOT change the password.
3. With the display now reading "SA1025.0", press the MENU button to advance.
4. With the display now reading "TA2005.0", press the MENU button to advance.
5. With the display now reading "PA3005.0", press the MENU button to advance.
6. With the display now reading "CO40.0", connect the zero-gas filter tube. Reset the zero gas calibration data by pressing the ENTER button once. Wait briefly, and continue to press the ENTER button until the display reads "CO 0.0 [or 0.1]".
7. Remove the zero-gas filter tube, and press the MENU button to advance.

---

1 SA=STEL Alarm
2 TA=TWA Alarm
3 PA=Peak Alarm
4 CO=Zero Gas Calibration

8. The display will read “Clu 100.0”. To make instrument mimic the HNu, change the standard calibration gas value by pressing ENTER to scroll left to right. Change the flashing numbers as needed by pressing the “∧” or “∨” buttons. The display should read “Clu 53.0”.
9. Once the ENTER key is pressed the fourth time to accept the calibration gas value, the display will read “GAS On”.
10. Connect the 100-ppm isobutylene calibration gas with 0.5-LPM regulator with direct tubing or 1.5-LPM regulator and T-tubing, and press the ENTER button.
11. The display will read “CAL” for about 30 seconds, and then will read “Cl 100.0 [+5ppm]”, indicating standard calibration gas value.
12. If the displayed result is not acceptable, continue to press the ENTER button to return to the calibration data to accept the displayed result.
13. Press the MENU button to exit calibration procedure, and disconnect the calibration gas.
14. Continue to press the MENU button to scroll through the “Clr ALL”, Hr xx.xx” for changes to time, and “dA xx.xx” for changes to date displays. The display should read “0.0” once the user has scrolled through and exited the above menu items.
15. Calibration comlete

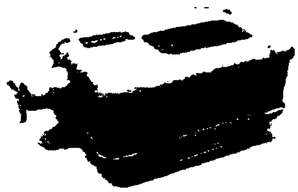
Troubleshooting

Troubleshooting Data		
Problem	**Possible Reasons**	**Possible Solutions**
1. Cannot turn on power after charging the battery	a. Bad battery connection	▪ Check battery connection
	b. Discharged battery	▪ Charge or replace the battery
	c. Defective battery	▪ Reset microprocessor by disconnecting, then reconnecting the battery
	d. Microprocessor hang-up	▪ If unit is Mini RAE "Plus," check white switch between changing and RS232 ports
2. No LED or LCD back light	e. Defective LED or LCD back light	▪ Call authorized service center
3. Buzzer inoperative	f. Bad buzzer	▪ Call authorized service center
4. Reading abnormally high	g. Dirty or wet sensor	▪ Clean sensor module
	h. Dirty probe assembly	▪ Clean probe assembly
	i. Dirty membrane filter	▪ Replace membrane filter ▪ Use water trap disk
5. Reading abnormally low	j. Lamp dirty or weak	▪ Clean or replace lamp
6. "Err xxx.x" message during operation	k. Dirty sensor	▪ Clean sensor
	l. Weak or defective lamp	▪ Replace lamp, filter

Troubleshooting Data		
Problem	**Possible Reasons**	**Possible Solutions**
7. Read a small background value	m. There is actually a background gas level n. Instrument zero drift	▪ Do zero-gas calibration ▪
8. Reading jumps randomly	o. Incorrect gas calibration p. Low sensitivity to cal gas	▪ Recalibrate ▪ Change filters ▪ Clean lamp ▪ Use different cal gas
9. Slow response to gas input	q. Leakage in probe assembly or sensor module	▪ Tighten the probe assembly and sensor module ▪ Make sure "O" rings are present
10. No air draw at gas inlet tube	r. Defective pump or leakage in probe assembly and sensor module	▪ Replace pump, tighten the probe assembly and sensor module ▪ Make sure "O" rings are present
11. "Lo bAt" message at power on	s. Discharged battery	▪ Recharge battery
12. Cannot turn off unit or corrupted characters in LCD display	t. Microprocessor hang-up	▪ Disconnect and reconnect battery ▪ Reload software from PC
13. Full-scale measurement in humid environment	u. Dirty or wet sensor	▪ Clean and dry sensor ▪ Use water trap disk to block out moisture
14. Measurement max out at certain level	v. Dirty lamp/sensor module w. Weak lamp	▪ Clean lamp/sensor module ▪ Replace new lamp
15. Calibration error message	x. No standard gas input	▪ Make sure standard gas flows into inlet probe

Troubleshooting Data		
Problem	**Possible Reasons**	**Possible Solutions**
	y. Low sensitivity to cal gas	▪ Change calibration gas ▪ Make sure calibration gas is attached during calibration

Multi RAE



Calibration Check

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6eV PID Lamp.

Start Up Instrument

- Press **Mode** button
- Observe displays:

On!........

Multi RAE Version X.XX

Model Number SN XXXX

Date Time Temp

Checking Sensor Ids....

VOC Installed

CO Installed

H_2S Installed

OXY Installed

LEL Installed

H_2S VOC CO LEL OXY

Alarm Limits=

XX XX.X XX XX High XX.X

XX XX.X XX XX Low XX.X

XX XX.X XX STEL

XX XX.X XX TWA

Battery = X.XV Shut off at 4.2V

User Mode=

Alarm Mode=

Datalog Time Left

Datalog Mode

Datalog Period

Unit ready in..... 10 Seconds

- The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

- Depress the **[N/-]** key first, then while depressing the **[N/-]**, depress the **[Mode]** key also and depress both keys for 5 seconds.
- Display will read:

Calibrate Monitor?

- Press the **[Y/+]** key
- Display will read:

Fresh Air Calibration?

- If "Zero Air" is necessary, attach the calibration adapter over the inlet port of the Multi RAE Monitor and connect the other end of the tube to the gas regulator (HAZCO loaner regulator LREG.5, RAE Systems P/N 008-3011 or suitable .5 LPM regulator) on the Zero Air bottle (HAZCO P/N SGZA, RAE P/N 600-0024). If no Zero Air is available, perform the Fresh Air Calibration in an area free of any detectable vapor.
- Press the **[Y/+]** key
- Display will read:

Zero.... In progress...

CO Zeroed! Reading = X

VOC Zeroed! Reading = X

LEL Zeroed! Reading = X

OXY Zeroed! Reading = X

Zero Cal done!
H_2S Zeroed! Reading = X

In each of the above screens, "X" is equal to the reading of the sensor before it was zeroed.

- Display will then read:

Multiple Sensor
Calibration?

- Press the **[Y/+]** key
- The display shows all of the pre-selected sensors and the "OK?" question:

CO H_2S
LEL OK? OXY

- Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.
- Press the **[Y/+]** key. Display will read:

Apply Mixed gas

Calibration
In progress ...

- The display will count down showing the number of remaining seconds:

CO cal'ed
Reading=50

H_2S cal'ed
Reading=25

LEL cal'ed
Reading=50

OXY cal'ed
Reading=20.9

Calibration done
Turn off gas!

- Display will read:

Single Sensor
Calibration?

- Press the **[Y/+]**.

- Display will read:

CO VOC H_2S
LEL pick? OXY

- Attach 100 ppm Isobutylene (HAZCO P/N r-SGISO or Rae P/N 600-0002) using a 1.0 LPM regulator (HAZCO P/N LR10HS or Rae P/N 008-3021). Open regulator.
- Press the **[Mode]** key once, the V of VOC will be highlighted.
- Press the **[Y/+]**. The display will read:

Apply VOC Gas

Calibration
In progress...

- The display will count down showing the number of remaining seconds:, then display:

VOC cal'd
Reading=100

Calibration done
Turn off gas!

Single Sensor
Calibration?

- Press **[Mode]** key twice to return to main screen.
- **CALIBRATION IS COMPLETE!**

Troubleshooting

As a general rule, if the readings are erratic, calibrate the PID. If this does not improve readings, clean the lamp. See operator's manual for instructions.

Flame Ionization Detectors (FID)

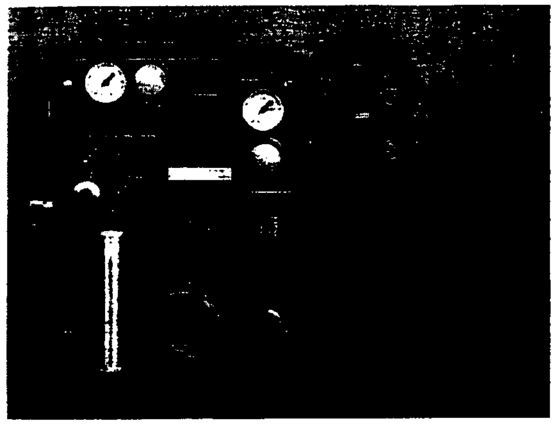
Portable FIDs use a hydrogen flame as the means to produce ions, instead of the ultraviolet light used by the PID. FIDs are used in similar situations as a PID, but they respond to a greater number of organic chemicals than PIDs and are linear over a greater range. The sensitivity of the FID to vapors depends on the energy required to break chemical bonds. Like the PID and ionization potentials, the FID will vary depending on a particular chemical. The detector response is proportional to the number of molecules, but the relationship is not linear and is skewed with organic compounds containing oxygen, nitrogen, sulfur, or chlorine. The FID uses a burner assembly in which hydrogen is mixed with the incoming sample gas stream, and this is fed into the jet where ignition occurs. The organic chemicals present in the gas stream form carbon ions. Positively charged carbon ions are collected on a negatively charged electrode. The current generated is proportional to the number of ions and concentration. Measurements using the FID are relative to the factory calibrant gas, usually methane. Before field operation, FIDs should be calibrated with a known methane concentration within the concentration range expected in the field. Once the meter is turned on and stable for at least one minute, the flame can be ignited. After lighting, the meter may be unstable, but should stabilize within 15 minutes. The FID can be zeroed in the field using the most sensitive setting and a background reading obtained. If clean, ambient air is not available for background readings, an activated charcoal filter can be attached to the sample inlet to remove all hydrocarbons except methane and ethane. FIDs have inlet particulate filters that prevent large particles from entering the combustion chamber and should be changed frequently.

Advantages:
- The FID is less sensitive to humidity than the PID.
- The FID is insensitive to ambient gases (water, nitrogen, oxygen, and most inorganic compounds, and has a negligible response to carbon monoxide and carbon dioxide) making the FID extremely useful in the analysis of atmospheric samples.
- If only one organic contaminant is present, it may be possible to quantify the contaminant if the FID has been calibrated for that specific contaminant.
- The molecular size of methane is too small to be trapped in the charcoal filter. In a case where the instrument is showing high readings in the field but methane is suspect, the charcoal filter can be placed on the sample inlet. Any other contaminants should be trapped. If the major contaminant is methane, then the reading will not show a significant change. If the reading drops notably, then another contaminant is present in substantial amounts.

Disadvantages:

- The FID responds to methane but does not distinguish between methane and other gases.
- The FID cannot represent the concentrations of specific organic compounds, only an estimate of the total concentration of volatile organic compounds unless used with a gas chromatograph.

Calibration Check



Ready Instrument

- Check that the instrument is fully charged with hydrogen (99.999%).
- Check the battery condition by moving the INSTRUMENT switch to "BATT"–observe the needle response on the probe/readout assembly (Note: LIFT switches first, and then move).

Start Up Instrument

1. Move the INSTRUMENT switch to the "ON" position, 5 minutes are needed for warm-up.
2. Move the PUMP switch to the "ON" position.
3. Use the CALIBRATION ADJUST knob to set the probe/readout assembly to read zero
4. Set the CALIBRATION SCALE switch to the "X1" position.
5. Check the SAMPLE FLOW RATE – the normal range is 1.5 to 2.5 LPM (if less, do not use). Check that there are no sample line leaks by placing finger over the probe inlet – the pump should stop – and then release finger.
6. Open the H_2 TANK VALVE and then H_2 SUPPLY VALVE. Allow approximately 5 minutes for the hydrogen to purge the system.
7. Ignite the flame by depressing the red igniter button on the left side of the instrument. Do not hold down for more than 5 seconds.
8. Once ignited, set the CALIBRATION ADJUST knob to set the probe/readout assembly to read zero.

Calibration Check and Adjustment

1. Set the CALIBRATION SCALE switch to the "X10" position.
2. Attach the 100 ppm methane cal-gas, using 1.5 LPM regulator with T-tubing to the instrument probe.
3. Unlock the GAS SELECT knob, and adjust to 3.0 + 1.5 until probe/readout assembly reads 100 ppm. If the GAS SELECT setting is not within the acceptable range, do not use the instrument.

4. Detach the cal-gas. Before monitoring, set the probe readout assembly arbitrarily to 1 ppm. If the needle goes flat (to zero), the flame may have been extinguished. The flame must be re-ignited before using.

Troubleshooting

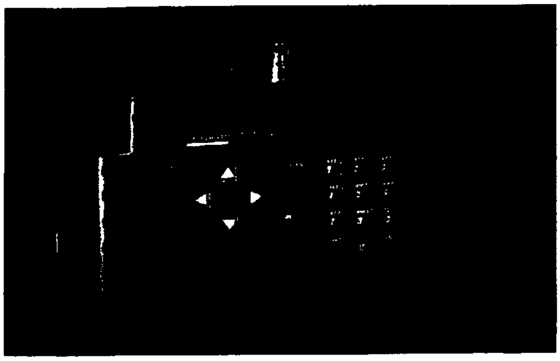
Troubleshooting Data

Problem	Possible Procedure	Possible Solution
1. Low sample flow rate on flow indicator	a. Check Teflon tubing on valve assembly for kinks, etc.	Straighten or replace Teflon tubing.
	b. Check flow rate with valve in down position.	Check for over-restriction of charcoal filter.
2. Hydrogen flame will not light	a. Check column connections on top of unit to make sure they are tight.	Tighten fittings.
	b. Check column for sharp bends or kinks. (Hydrogen flows through this column at all times, and a sharp bend will compact packing too tightly for proper hydrogen flow.)	Replace column.
	c. Check charcoal filter fittings to make sure they are tight.	Tighten fittings.
	d. Check hydrogen flow rate from the column.	Adjust hydrogen pressure to obtain 12 cm^3/min flow rate.

Troubleshooting Data		
Problem	**Possible Procedure**	**Possible Solution**
	e. Check that the inject and backflush valves are both completely in or out. A partially activated valve will block the hydrogen and air flow paths.	Ensure both valves are either completely in or out.
	f. If a new column was installed prior to identifying the problem, check for proper hydrogen flow rate through the column (should be approximately 12 cm/min).	Increase hydrogen pressure to obtain proper hydrogen flow rate, or if column is excessively restrictive, replace or repack the column.
	g. Allow time for hydrogen to reach ionization chamber.	Wait several minutes before igniting flame.
3. Ambient background reading in clean environment is too high	a. Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going into the chromatographic mode.	Replace activated charcoal in charcoal filter assembly.
	b. Check for contamination in column.	Replace or clean column.

Troubleshooting Data		
Problem	**Possible Procedure**	**Possible Solution**
	c. Check for contamination in column valve assembly.	Remove valve stems and wipe with clean lint-free cloth. Heat valve assembly during operation to vaporize and remove contaminants.
4. Flame-out when operating either valve	a. Ensure valves are being operated with a quick, positive motion.	Operate valve with a positive motion.
	b. Either hydrogen or air may be leaking around one or more of the valve quad rings. Assess by tests and O-ring inspection.	Remove stems and lightly coat with silicone grease, only on contact surface of the O-ring. Wipe off excess (do not remove quad rings).
	c. Damaged or worn quad rings causing leak.	Replace quad rings and grease as above.

TVA 1000



Calibration Check

Ready Instrument

- Check that the instrument was charged overnight.
- Check that the cylinder is fully charged with hydrogen (99.999%).

Start Up Instrument

1. Press the ON button and verify that the instrument completes the self-diagnostic test, which takes approximately 15 seconds.
2. To turn on pump, press "CONTROL".
3. Press "1" to turn on pump.
4. To ignite the flame, open the hydrogen valve on the side of the instrument and
wait 30 seconds. Press "CONTROL" and then "2". After "2" has been pressed,
the main menu will be displayed.

Calibration Check and Adjustment

1. Press "2" and then press "1".
2. Press "2" to zero to ambient air. When the calibration is complete, the display will briefly display "ACCEPTED".
3. To select the gas concentration of the calibration gas, press "4".
4. To change the concentration to a new value, press "3".
5. Use the up and down keys to select %, ppm, ppb, and decimal point position.
Then type the numerical value for the concentration. Press "ENTER" to store the value
and press "EXIT" to return to the calibration menu.
6. From the calibration menu, set the span to 1.00 by pressing "5".
7. To change the response factor to a new value, press "3".
8. Type "1.00" and press "ENTER" to store the value.
9. Press "EXIT" to return to the calibration menu.
10. Calibrate the instrument by pressing "3" twice.
11. Connect the span gas and then press "ENTER". When the calibration is complete,
the display will briefly display "ACCEPTED".
12. Press "EXIT" to return to the main menu.
13. To take a measurement, press "1".

Troubleshooting

When the analyzer is operating, dust or other foreign matter could be drawn into the probe, forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings.

- If the battery is low, recharge the instrument.
- Fill the hydrogen tank by attaching the filling hose. Bleed the hose before filling or you will get high background readings.
- Charcoal filters are used to screen methane. Your action levels are based on non-methane readings, so you need to use the difference between the readings with and without the filter.

Combustible Gas Indicator (CGI)

Combustible gas instruments were the first direct-reading instruments to be developed; British miners used CGIs to detect methane in underground mines. Today CGIs are used to measure gases in confined spaces and atmospheres containing flammable and combustible gases and vapors. The instruments measure the presence of flammable and combustible gases in percentage of lower explosion limit (LEL). The CGI is primarily a safety meter used to detect hazardous condition concentrations up to 100% of the LEL. When 100% of the LEL is reached, flammable or explosive concentrations are present. CGIs cannot be used to determine compliance with occupational exposure limits.

Most CGIs in use today operate on the basis of catalytic combustion. The air containing the contaminant passed over a heated catalytic filament, which is incorporated into a Wheatstone Bridge. A Wheatstone Bridge is a circuit that measures the differential resistance in an electric current. The catalytic sensor contains two filaments; one is coated with a catalyst (usually platinum) to facilitate oxidation or combustion of very low concentrations of a gas. The other filament, the compensating filament, operates at the same voltage as the catalyst, but does not cause oxidation and therefore does not increase in temperature.

The other common method of operation for CGIs is based on thermal conductivity, which uses the specific heat of combustion of a gas or vapor as a measure of its concentration in air. This method is not sensitive to low concentrations of gases. Typical applications include pipeline leaks, tank farms, and landfills.

All CGI readings are relative to the calibrant gas (either methane, propane, pentane, or hexane). CGIs should be calibrated under the same conditions as those in the field. The response of the instrument should be within the manufacturer's acceptable limits.

CGIs should always be used in conjunction with oxygen sensors. CGIs that use a catalytic sensor, require the sample air to be oxidized or burned on the filament. If the concentration of oxygen in the ambient air is too low, the measurement will be too low. The oxygen concentration should be measured first, since the CGI performance depends on oxygen availability.

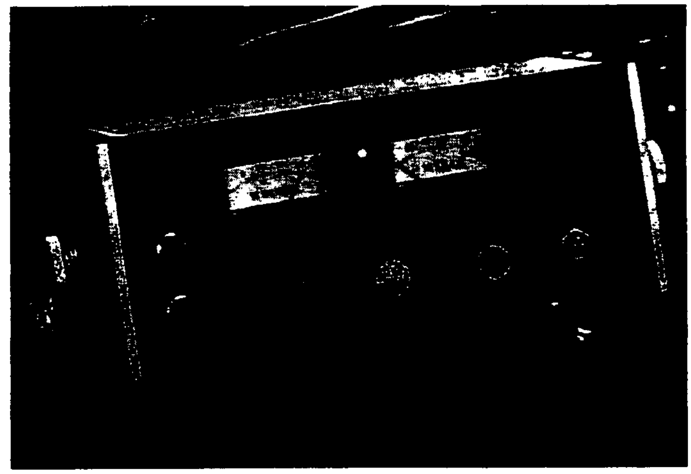
Active CGIs use a small pump to pull the atmospheric sample through a filter and then into a manifold block in which the oxygen sensor and combustible gas diffusion head are mounted. Passive CGIs use the diffusion principle to carry the atmospheric sample to the sensors.

Advantages:
- Small, hand-held.
- Can be calibrated for a single vapor or known mixtures.

Disadvantages:
- Not specific.
- Give false indication of safety when oxygen concentration is less than 8%.
- Do not give ppm measurements.

MSA Model 260, 261

Calibration Check



Ready Instrument

- Check that the instrument was charged overnight.
- Turn the FUNCTION knob to manual "HORN OFF" position.
- Verify that flow indicator is red.

Zero Instrument

- Zero the instrument within 30 seconds after turning instrument on. Set the readout to "00% LEL" by adjusting the ZERO LEL knob (Note: lift the knob first, then turn.) This is to be completed in a clean area.
- Set the readout to "20.8% OXY" by adjusting the CALIBRATE OXY knob.

Calibration Check and Adjustment

1. Connect cal-gas (0.75% pentane), with a 1.5 LPM regulator via direct tubing, to the sample port on the left side of the instrument.
2. Check that the readout is "50% LEL", + 5% LEL. If the "%LEL" is not within the acceptable range, do not use the instrument.
3. Check that the readout is "15% OXY", + 2% OXY. If the "%OXY" is not within the acceptable range, do not use the instrument.
4. Press the RESET button to clear alarm indicators.

Troubleshooting

- Flow problems. Should flow continue when the inlet is shut, a leak in the flow system is indicated. Stop off the flow at the pump inlet, making sure the pump stalls. Work back the flow path toward the sample inlet until the leak is identified.
- If during calibration-check procedures the readings do not fall within acceptable ranges stated above, a qualified individual must perform internal calibration.

The user MUST be familiar with the instrument's limitations (e.g., interfering compounds that foul the detector, low-battery operation, readout latch, etc.).

Real-Time Aerosol Monitor

Direct-reading field instruments for aerosols can determine total mass, total count, and particle size distribution. The most popular direct-reading aerosol monitors are light scattering devices that operate by illuminating an aerosol as it passes through a chamber and by measuring the light scattered by all the particles. When particles are drawn into the instrument, the intensity of the light scattered into the detector can be used to estimate concentration. As the number of particles increases, the light reaching the detector increases. The amount of light scattered by a particle into the detector depends on the size, shape and refractive index of the particle.

The MiniRAM is an airborne particulate monitor whose operating principle in based on the detection of scattered electromagnetic radiation in the near infrared. The MiniRAM is a light scattering aerosol monitor, i.e., the instrument continuously senses the combined scattering from the particles present. The instrument should be positioned vertically to minimize potential particle deposition within the sensing chamber. The MiniRAM should be factory calibrated periodically, and is field calibrated using the Z-Bag. The MiniRAM is placed inside the Z-Bag, which provides a clean-air environment. The MiniRAM can be used to measure the concentration of all forms of aerosol: dusts, fumes, smokes, fogs, etc. MiniRAM provides a data logging system, with several styles of print outs of zero or measured data.

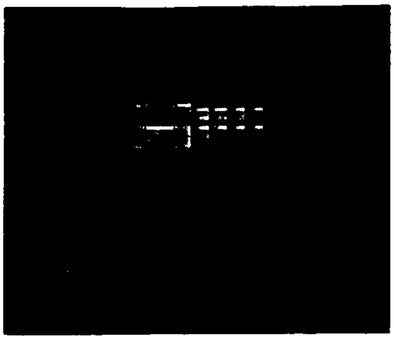
Advantages:

- Easy to use.
- Instantaneous readout.
- Permit measurement of the principal characteristics of liquid and solid particles in an unaltered airborne state.
- Capable of measuring particle concentrations in air as low as a fraction of a milligram at the appropriate sampling rate.
- The rate at which air passes through the sensor does not influence the indicated concentration. Flow rate only influences response time.
- Can run without a time limit through an A/C line using charger that is provided.
- Small and light, so it works well as a personal monitor, but the MiniRAM may also be used as an area monitor for both indoor and ambient air situations.

Disadvantages:

- Rechargeable Ni-Cd batteries can provide power up to 8.5 hours, but the device sometimes does not fully charge (although a full charge is indicated) and shuts off during sampling.
- Illumination and detection lenses, windows in sensing chamber, and interior walls may become contaminated with particles, causing inaccuracy in measurements.
- All stored data will be lost if batteries are disconnected.
- Unable to measure particle size (i.e. respirable fraction).

MiniRAM



Calibration Check

Ready Instrument

- Check that the instrument was charges overnight.

Start Up Instrument

- If the miniRAM shows a blanked display, press OFF and wait until the display reads "OFF", before pressing MEAS to initiate measurement cycle.
- If the miniRAM shows "OFF", press MEAS directly to initiate measurement cycle.
- Concentration display that changes or "blinks" once every 10 seconds indicate the miniRAM is in the measurement mode.

Calibration Check and Adjustment

1. Remove rubber bulb filter assembly from Z-Bag. Place Z-Bag on flat surface with red flow fitting facing up. Flatten bag. Remove small plastic cap from flow fitting on bag.
2. Insert ribbed elbow connector into red flow fitting of plastic bag, until connector is flush with bottom of red flow fitting.
3. MiniRAM should be in its OFF condition. If display is blanked, or if miniRAM is in the MEAS mode, key OFF.
4. Open Z-Bag and place miniRAM inside, approximately at its center.
5. Key ZERO through the open end of the Z-BAG. Immediately zip closed the Z-bag and begin to pump hand bulb.
6. Z-Bag should inflate as hand pumping continues, up to a height of about 5 inches. Continue pumping gently to maintain bag interior pressure, until the miniRAM displays OFF again.
7. Unzip Z-Bag and remove miniRAM. MiniRAM is now ready for monitoring.
8. Place rubber bulb/filter assembly inside Z-Bag, and plug small plastic cap into flow fitting to close it. Zip close while flattening Z-Bas to store it to ensure cleanliness of the bag interior.

Troubleshooting

1. No response when OFF key is pressed, display remains blank
    a. Batteries exhausted, recharge battery pack. If after charging, unit still does not function, check the following:
    b. Measure output of battery charger. A volt meter should read about 24.5 Va.c.

c. Of charger is ok, remove battery pack an slightly separate 2 gray connectors. Attach voltmeter + lead to red wire and – lead to black wire. Voltmeter should read about 8.5 Vd.c. while plugged into the charger.

d. If battery pack is ok check the fuse on the circuit board. Fuse is located 3/8 inch behind analog output jack and is designated F on the circuit board. Leaving the – lead of the voltmeter connected to the battery pack use + lead to check voltage on both sides of fuse. Voltage should be the same as in C above. If not, fuse must be replaced. This is preferably done at the factory.

2. Unit constantly displays .0.3-

This indicates electronic component failure. Unit should be sent back to MIE for repair and recalibration.

3. Improper display segments appear

Usually an indication that the circuit board and/or display board has been contaminated. This may be corrected by removing the battery pack and cleaning affected areas with a small brush. Do Not Use any cleaning fluids or solvents on circuit board. If brushing does not correct problem unit should be sent to MIE for repair.

4. Pressing TWA, ID, TIME, keys, etc. during MEAS mode causes unit to shut off

a. Keypad failure: Unit should be sent for repair

b. Display board contamination: clean board as in 3 above.

Colorimetric Indicator Tubes

Colorimetric or detector indicator tubes, are the mostly widely used direct reading devices due to their ease of use, minimum training requirements, fast on-site results, and wide range of chemical sensitivities. A detector tube is a hermetically sealed glass tube containing an inert solid or granular material, such as silica gel, alumina, pumice, or ground glass. The inert material is impregnated with one or more reagents that change color when they react with a chemical or group of chemicals. The reagents are selected for specific chemicals or group of chemicals and may vary by manufacturer. When exposed to the contaminant, a chemical reaction causes a color change that is proportional to the concentration of the contaminant. The tubes are scribed with gradations to note the length of the stain to decipher the concentration. Most tubes are marked in ppm and can be read directly, but some scales require a conversion. The manufacturer usually packs ten tubes per box and marks the tubes with the expiration date, which is usually one to three years. Some tubes suggest special storage specifications such as refrigeration.

Pumps must be leak tested before each use and periodically sent to the manufacturer for flow testing. To take a sample, the sealed ends of the tube are broken off and the tube is attached to the correct pump (the tubes and the pump must be from the same manufacturer). Air is drawn through the tube at a set flow rate and number of strokes. Selecting the orifice size sets the flow rate. Pumps draw a preset volume with each stroke; the number of strokes will be indicated in the manufacturer instructions. Adequate time must be left between strokes to allow the pump to completely fill with air. Time depends on the orifice size and the type of detector tube.

Advantages:

- Simple to operate.
- Inexpensive.
- Quick results.
- Correction factors are usually included in the instruction sheet to use when environmental conditions are abnormal.

Disadvantages:

- Environmental conditions (temperature, pressure, and relative humidity) may affect accuracy.
- Field measurements can vary as much as 25%.
- Interferences of other chemicals may cause false readings.

Gastec

Calibration Check

Ready Instrument

- Perform leak check by placing an unopened tube into socket and attempting to draw air by stoking the pump once. If the white disk, flow indicator, does not appear after 10-15 minutes the lead check is complete. If leak check is successful sampling may begin.
- Gastec contaminate specific tubes must be used. Inside the package of tubes specific instructions will be given as to the number of strokes needed and the allowable time limits.

Sampling Procedures

1. Using the built in tube breaker, break both ends from the tube. Use caution with broken glass.
2. Confirm the pump handle is fully pushed in and then insert the detector tube into the rubber flange of the pump with the arrow on the tube pointing toward the pump.
3. Align the correct volume selection mark on the pump handle with alignment mark on pump body.
4. Firmly pull out the handle fully (for 100 ml sampling) or halfway (for 50 ml sampling) along the guideline to the lock position according to tube instructions.
5. Wait until sampling time has elapsed. A small white disc will become visible in the flow finish indicator in the handle when sampling is completed. The white indicator or the flow finish indicator is pulled in by the vacuum generated in the pump cylinder. It pops out when the prescribed volume has been fully sampled.
6. Repeat above step if multiple strokes are needed.
7. When finished with strokes, remove the tube from the pump and read the value at the end of color stain according to tube instructions.

Troubleshooting

- Never modify or disassemble pump sections, such actions may invalidate warranty conditions.
- Major causes of air leak with the pump are loosened inlet clamping nut, damaged or deteriorated rubber inlet, and discolored lubricant or insufficient lubricant. Contact manufacturer to help determine if replacement parts should be ordered or if service is needed.

Drager

Calibration Check
Ready Instrument

- Perform pump leak test by insert unopened tube into socket, squeeze pump completely and release. Pump is adequately leak-proof if the end-of-stroke indicator had not appeared after 15 minutes.
- Drager contaminate specific tubes must be used. Inside the package of tubes specific instructions will be given as to the number of strokes needed and the allowable time limits.

Sampling Procedures

1. Using the built in tube breaker, open both tips of the tube.
2. Reset the stroke counter to "0".
3. Insert tube into pump, the arrow must point towards the pump.
4. Squeeze pump completely and release. When the end-of-stroke indicator appears, squeeze pump completely again. Repeat until the number on the stroke counter corresponds to that given in the instructions for use.
5. Evaluation of the results in accordance with the instructions for use of the tube in question.
6. Remove used tube from socket.
7. Flush pump with a few pump strokes in clean air.

Troubleshooting

- If leak is detected, inspect socket for damages or cracking socket. Replacement sockets and exhaust valves can be purchased and replaced as needed.

Air Sampling

Air sampling refers to the use of an air sampling pump and collection media (or other appropriate means) to obtain air samples of contaminants of concern. The air sampling pump causes air to be drawn through the collection media at a constant, predetermined flow rate. Samples must later be run through a separate analysis process in order to determine contaminant concentrations. Results are typically reported as a time-weighted average, the generic term that refers to any 8-hour Occupational Exposure Limit (OEL) (such as, PEL, or TLV) in part per million (PPM) or mg/m^3. This concentration is used to specify engineering controls and PPE requirements, and to demonstrate compliance with hazard (exposure) limits.

Air sampling methods tend to be more precise in the quantification and identification of contaminants than direct reading air monitoring. Air sampling may be performed to supplement direct reading air-monitoring results. Under specific situations, some safety regulations require air sampling for exposure to certain contaminants (asbestos, lead, and cadmium for example). Air sampling is also used for potential airborne organics, inorganic vapors, gases and aerosols (dusts). Air sampling pumps must be calibrated according to the guidelines in the calibration procedure section for both personal and area sampling.

The limitations of air sampling are: the air sampling duration is typically 8 hours, availability of laboratory analysis ranging from days to weeks, and results are not available in real-time. Air sampling is expensive, with costs ranging from $50 to $500 per sample. Results must be compared to a hazard (exposure) limit for a specific chemical (for example, the PEL, REL, or TLV).

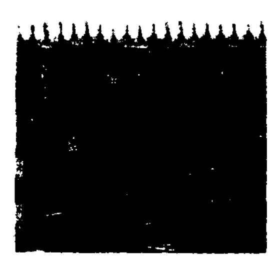
Personal Sampling

Personal samples are collected in the breathing zone of a worker, which is defined as a half-sphere around the head of the employee being monitored and forward from the plane of the shoulders. Personal air sampling is used to average the varying range of contaminant concentration levels with time and activities performed over a defined period of time.

Area Sampling

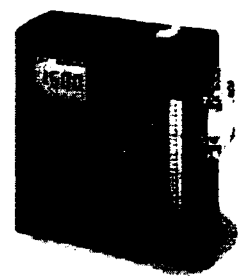
Occasionally additional information is needed to accompany the data recorded through personal breathing zone sampling. Samples may be taken at a specific operation or in a general work area to help assess the potential exposures. The positioning of these samples can help to determine a source of contamination or evaluate engineering controls. The type of information desired should contribute to the overall sampling strategy. Your RHSPM will determine whether personal breathing zone or area samples will be collected.

Sampling Supplies



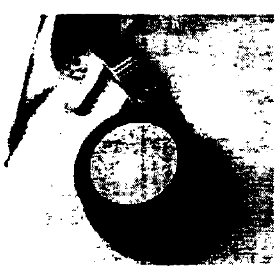
Specific analytical methods will require various types of sampling collection media to be used. The most common media are cassette filters and sorbent tubes. Gases and vapor are typically collected in sorbent tubes that contain small granules or beads that adsorb the contaminate. Liquids or particulates are more commonly collected on filters , which can be either treated or untreated. The specific analytical method will determine the most appropriate collection device. Various analytical methods exist, both NIOSH and OSHA have published databases of validate methods. The RHSPM will specify sampling methods needed and communicate with the SC.

Sampling Equipment



Sampling pumps are produced by a variety of manufacturers but all work in the same manner. The principle is to pull, by suction, a constant amount of air through the collection device in line. Sampling pumps are to be calibrated to within 5% of the established flow rate. Most pumps are powered by rechargeable battery packs that can be used for an extended period of time. Various options can be built into pumps such as timers, fault shutdown, and computer compatibility.

Organic Vapor Badges

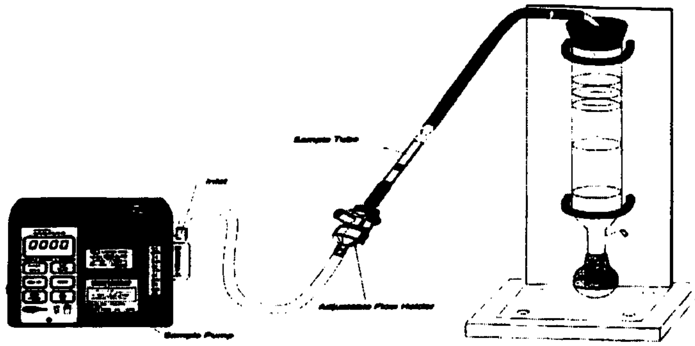


Organic vapor badges are passive collection devices that do not require sampling pumps. These badges are small charcoal disks in a plastic holder that can be used either as personal or area samplers. Laboratory analysis is required for contaminate identification. Such samples are inexpensive and easy-to-use but do not have OSHA or NIOSH methods to reference ensuring reliability. Your RHSPM will determine if these badges are appropriate.

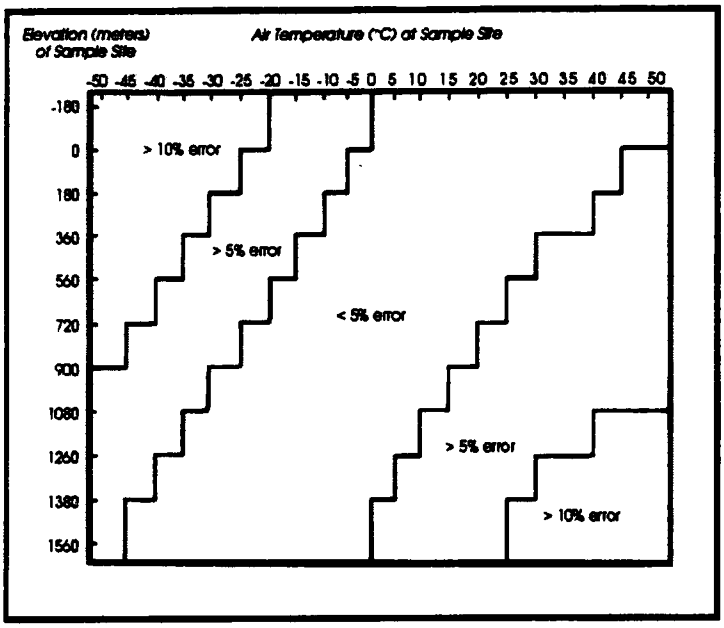
Calibration Procedures

Calibrate personal sampling pumps before and after each day of sampling, using either a primary calibration standard (bubble or graphite-piston meter) or a precision-rotameter calibrated against a primary calibration standard. Make sure that the primary calibration equipment is within its prescribed calibration interval, most manufactures recommend annually, reference the operations manual to confirm requirements. Documentation of the calibration process should be recorded on the Air Sampling Pump Calibration and Data Collection Form contained in this document.

The sampling train should be connected with the sampling pump, the calibration device, and the required collection media (see diagram below).



Additional calibration procedures are needed when calibration occurs at a different elevation from the sampling is conducted. A table of correction factors is included in the manufacturers' manual for electronic soap bubble meters. Some calibrators, such as the frictionless piston meters, contain internal temperature and pressure sensors to automatically correct readings. All adjustments should be noted on the Calibration Documentation Form. Use of rotameters will require manual calculations referencing established equations. A graph of the various margins of error by difference is elevation and temperature is illustrated below.



Source: AIHA Publication *The Occupational Environment- It's Evaluation and Control*

All calibration procedures as well as sampling methods should remain constant between both the personal and area samples for each specific contaminate

Sample Volume

The sample volume is dependent on the time of the sampling period and the flowrate of air pulled through the collection media. Calculating the volume of air drawn through the collection media during the sampling period is crucial in the accurate reporting of the exposure concentration. The total sampling time, in minutes, should be determined from the start and stop times. If the sampling pump is turned off during breaks or lunch, the start and stop times must be recorded on the Air Sampling Data Form. If the sample being collected is a breathing zone sample, then the pump should be turned on immediately before placing on the worker and turned off prior to removal of sampling apparatus from the worker.

The sample flowrate is based on the pre and post-calibration averages. The sampling train, as discussed previously must be calibrated prior to each use with the sampling pump at full battery charge. The sampling train will be connected to the calibration instrument. After the flowrate has been adjusted to within 5% of the recommended flowrate specified by the analytical method, take 3 readings. If all 3 readings are within 5% of the recommended flowrate, then average the readings to obtain your pre-calibration flowrate.

After the sampling period is completed, a post-calibration is required prior to the pump battery being recharged. The process is similar to the pre-calibration process, except the flowrate is not to be adjusted. Simply connect the sampling train to the calibration instrument and record 3 flowrate readings and average. The average flowrate is listed on the Air Sampling Data Form as the post-calibration flowrate.

The next step is to compare the pre and post-calibration flowrates to determine the sample flowrate. If the pre and post-calibration flowrates are within 5% of each other, then average the two to determine the sample flowrate. If the difference between the pre and post-calibration is greater than 5% but less than 10%, the lower of the two flowrates will be used as the sample flowrate. If the comparison of the pre and post-calibration flowrates indicates a difference of greater than 10%, the difference is too great to accurately estimate a flowrate and the sample must be voided.

If the temperature, pressure or altitude of the sample collection process is different than the conditions of the
pre and post calibrations, the flowrate may have to be adjusted. To adjust the sample flowrate the following equation is to be used:

$$\underline{\text{Calibration Conditions}} \qquad\qquad \underline{\text{Sampling Conditions}}$$

$$\frac{\text{(Volume) (Pressure)}}{\text{Temperature}} = \frac{\text{(Volume) (Pressure)}}{\text{Temperature}}$$

The sample flowrate is then multiplied by the sample time to obtain the sample air volume, which is usually reported to the analytical laboratory in liters of air.

Field Blanks
Along with each set of air samples, field blank samples will be included with the shipment of samples to the laboratory. Field blanks are used to determine accidental contamination of the samples during the handling and shipping process. Field blanks should be of the same media type and lot number as the media used for each type of sample collected. One blank should be submitted with each 10 samples for any given analysis/sampling period as the general rule. Some specific sampling and analytical methods will require additional blanks. Prior to shipping consult the sampling and analytical method or laboratory to determine the number of blanks. The blanks should be opened but not used to take samples (charcoal tubes, filters etc.). They should be handled in the same manner as any sampling media used in sampling air contaminants, with the exception that no air is drawn through them. The blanks should be labeled as blanks or noted on the laboratory analysis sheet as a blank.

Shipping Information
Prior to shipping, check with the analytical laboratory or your RHSPM for any special shipping requirements. Some samples are required to be shipped cold. Most samples will be shipped to the laboratory by overnight delivery. Try not to ship samples to the laboratory on Friday, unless you have arranged with the laboratory for a Saturday delivery. Please note that overnight delivery services have been known to not deliver packages on Saturday even though the shipping papers specify Saturday delivery. The samples will be staged in uncontrolled environmental conditions that may affect the samples. If samples need to taken on Friday, check with the laboratory to see if the samples could be refrigerated over the weekend and then shipped out of Monday.

Do not ship samples without thoroughly completing the chain-of-custody form. The lab completing the analysis should provide the appropriate form. If not, use the Chain-of-Custody Form found in this guide.

Occupational Exposure Limits (OEL)

Background

The necessity to establish acceptable levels for exposure to workplace contaminants was recognized as early as the 1920's. The Bureau of Mines and the Bureau of Standards compiled these early lists. In the 1940's the American Standards Association, known today as the American National Standards Institute (ANSI), and the American Conference of Governmental Industrial Hygienists (ACGIH) established maximum allowable concentrations. In 1960 the term "maximum allowable concentration" was discarded and the Threshold Limit Value (TLV) was introduced.

United States OELs

Threshold Limit Value (TLV)

TLVs refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit. A smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness.

TLVs are based on the best available information from industrial experience, from experimental human and animal studies and, when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others. The amount and nature of the information available for establishing a TLV also varies from substance to substance. The precision of the estimated TLV is also subject to variation and the latest TLV documentation should be consulted in order to assess the extent of the data available for a given substance.

The TLVs are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential health hazards and for no other use. TLVs and TLV Documentation are updated annually.

Permissible Exposure Limits (PEL)

The Occupational Safety and Health Administration (OSHA) in 1970 established PELs. They are United States legal limits, which shall not be exceeded. The majority of the PELs were adopted from ANSI standards and ACGIH TLVs

Recommended Exposure Limit (REL)

RELs are established by the National Institute for Occupational Safety and Health (NIOSH) as the scientific basis for OSHA to use in the standard setting process. Due to the breakdown in the PEL process, RELs remain as recommended limits and are not enforceable. RELs given as TWAs are based on a 10-hour workday during a 40-hour workweek.

International OELs
Numerous countries besides the United States are active in establishing OELs for their specific working conditions. Many are based upon the ACGIH TLVs. Some notable international OELs are:

Maximum Concentration Values in the Workplace (MAK)
MAKs are established by the German Commission for the Investigation of Health Hazards of Chemical Compounds.

Occupational Exposure Limits (OEL)
OELs are established by the Great Britain Health and Safety Commission. These OELs are enforceable by law. Great Britain also has OELs that serve are recommend levels and are approved by Britain's Health and Safety Executive.

OEL Types
OELs are expressed in different types of limits or levels. The limits or levels listed are used on a chemical specific basis to define the period of time and concentration a worker may be exposed. The RHSPM or HSM use the different types of OELs to determine the appropriate sampling strategy and equipment uses these limits or levels.

Action Level (AL)
The AL is the concentration at which a certain action is required. The AL is variable but in the industrial setting it is usually 50% of the PEL. Some substance-specific OSHA standards require medical monitoring, workplace monitoring, training, and labeling at the action level.

Time Weighted Average (TWA)
PEL The employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded.

TLV The time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

REL The employee's average airborne exposure in any 10-hour work shift of a 40-hour work week which shall not be exceeded.

Ceiling Values
PEL The employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time over a working day.

TLV/REL The concentration that should not be exceeded during any part of the working exposure.

Short Term Exposure Limit (STEL)

PEL The employee's 15-minute time weighted average exposure, which shall not be exceeded at any time during a work day unless another time limit is specified in a standard.

TLV A 15-minute TWA exposure which should not be exceeded at any time during a work day even if the 8-hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. An averaging period other than 15 minutes may be recommended when this is warranted by observed biological effects PEL

Skin Designation

To prevent or reduce skin absorption, an employee's skin exposure to substances listed with the designation "skin" shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

TLV Skin Listed substances followed by the designation "skin" refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eyes, either by airborne or, more particularly, by direct contact with the substance. Vehicles present in solutions and mixtures can alter skin absorption

Excursion Limits

TLV Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a workday, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.

Mixtures

PEL In case of a mixture of air contaminants, an employer shall compute the equivalent exposure as follows:

$$E_m = (C_1/L_1 + C_2/L_2) + \dots (C_n/L_n)$$

Where: E_m is the equivalent exposure for the mixture.
C is the concentration of a particular contaminant.
L is the exposure limit for that substance specified in Subpart Z of 29 CFR 1910.

The value of E_m shall not exceed unity (1).

TLV When two or more hazardous substances which act upon the same organ system are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions,

$C_1/T_1 + C_2/T_2 + \ldots C_n/T_n$

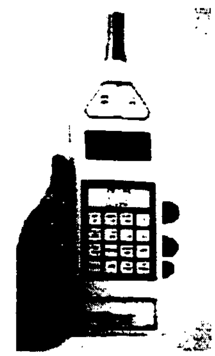
exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C_1 indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit.

Immediately Dangerous To Life and Health (IDLH

The maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing (e.g. severe eye irritation) or irreversible health effects. These values were determined only for the purpose of respirator selection

Sound Level Meters

The basic instrument for the measuring sound levels is the sound level meter (SLM). The SLM consists of a microphone, preamplifier, amplifier, frequency weighting filters, and a digital or analog readout. Most SLMs provide at least two options for frequency weighting: A and C.



Measurement Procedures

To characterize specific noise sources, hand held or tripod mounted sound level meters are typically used. Measurements can be taken in either A, B, C or flat weighted levels. These weightings can be simply thought of as correction factors for various types of environments based on sound level pressure. SLM models will vary but most are equipped with dBA and dBC. A-weighted measurements are most frequently used and emulate the human ear at lower sound levels. B-weighted measurements represent moderate sound pressure levels and are seldom used. C-weighted measurements are typically used at high sound levels for such applications as impact noise characterization. Flat measurements are a flat frequency response without any correction factor. As well as varying weightings, the response time is also somewhat adjustable. Most SLM have the capabilities of fast and slow response. Fast response is a very rapid adjustment to the change in sound level. Slow response is a delayed reading that tends to average the change in sound level. The most common settings used for investigations and various compliance surveys are dBA with slow response.

For a complete and accurate noise survey, walls and corners should be avoided. If possible, measurements should be taken in relatively open areas. The SLM must be positioned at ear height while collecting measurements. If fluctuations of 3 dB are recorded then the minimum, maximum, and median readings should be noted in the data log.

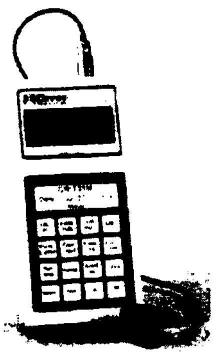
General Calibration

Calibration must occur, at a minimum, before and after each use. It is a best practice to verify calibration after four hours of use. Additionally, factory calibration of the calibrator itself should be conducted annually. Prior to calibration of the sound level meter (SLM), the battery level should be verified and replaced as necessary. Temperature stabilization for .5 hours is required if there is a change of >20^{o}F (>10^{o}C) in temperature. Place the proper adapter, to accommodate for the microphone size, into the top of the calibrator and slightly twist to ensure an adequate seal. With the SLM turned on, gently insert the microphone into the calibrator. To ensure accuracy, the microphone must be seated squarely into the calibrator. Turn calibration unit on and allow 15 seconds for the SML to stabilize. Models will vary so selection of the frequency and amplitude may be required on the calibrator. Comparison between the selected output and the SLM reading will determine the amount of adjustment required. If needed, adjust SLM according to the manufacturer's instructions. Note that excessive background sounds should be eliminated so not to effect calibration procedure measurements.

Calibration Adjustments for Altitude

Barometric pressure and elevation above sea level will effect the function of the SLM. To accommodate for this, additional calibration procedures may be needed. The SLM manufacturer will provide a graph or table to correlate the correction factor needed for various altitudes and barometric pressures. Cavity volume changes, due to the calibrator's vibration against the internal diaphragm, create the reason for such variation.

Personal Measurement Procedures



Personal noise dosimeters or sound exposure meters are used to gather an individual's noise dose over a full work shift. Specific exchange rates, criterion level, and threshold values must be taken into consideration. Exchange rate is the exposure time to noise level relationship that is also referred to as doubling rate. The most common exchange rates are 3 dB and 5 dB. **CH2MHILL**'s company policy is to use the 3dB rate. This means that an incremental 3-dB increase or decrease in sound level will halve or double the exposure duration. All measurements will be recorded as A-weighted unless the dosimeter or sound exposure meter is intentionally programmed otherwise.

The dosimeter or sound exposure meter should be placed with the microphone high on the shoulder and away from the neck, preferable attached to a shirt collar. The body of the unit can be placed in a pocket or attached to a belt, just as many other personal sampling devices are designed.

Sampling Documentation

Log Books
The following calibration information must be documented in the project records for direct reading instrument calibration:

- Instrument name
- Serial number
- Owner of instrument (for example, CH2M HILL, HAZCO)
- Calibration gas (including type and lot number)
- Type of regulator (for example, 1.5 lpm)
- Type of tubing (for example, direct or T-tubing)
- Ambient weather condition (for example, temperature and wind direction)
- Calibration readings
- Operators name and signature
- Date and time

In addition to the calibration information, the following information regarding air monitoring and sampling results must be recorded in the project records:

- Instrument reading
- Weather conditions
- Sample location (breathing zone, headspace)
- Operator's name and signature
- Date and time

The Air Sampling Data Form and Chain of Custody Forms should be retained as part of the project file.

Exposure monitoring records must be preserved according to the guidelines established in HSE-15, Recordkeeping SOP.

Industrial Hygiene

Chain-of-Custody Record

__________ Region

Division Name:

______________________________Telephone:______________________

Address:____

____

City: ____State:

_____________Zip: ______

Collector's Name: _________________________________Telephone:

____

Send Results to:

Name: ____

Site: ____

Address: ____

____

Sample Submitted to:

_________________________________Date:____________________

(Laboratory)

SAMPLE NUMBER	SAMPLE DATE	MEDIA	SAMPLE VOLUME	ANALYSIS REQUIRED

Chain of Possession*:

1. __________________________ __________________________

____

Signature of Sender Title Inclusive Dates

2. ______________________ ______________________

____

Signature of Sender Title Inclusive Dates

3. ______________________ ______________________

____

Signature of Sender Title Inclusive Dates

*Apparent gaps or breaks in the Inclusive Dates are covered by site sample shipping and receiving logs.

STANDARD OPERATING PROCEDURE
HORIBA U-10/U-22 MULTI-PARAMETER WATER QUALITY MONITORING SYSTEM

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the protocol for the field operation of a Horiba U-10 or U-22 Multi-Parameter Water Quality Monitoring System. The Horiba U-10 and U-22 model instruments incorporate the same monitoring probes, user interface systems, and calibration procedures, but are configured for batch sampling (U-10) or use with an in-line flow-through cell (U-11). The instruments are equipped with several probes used to measure specific field chemistry parameters including pH, oxidation reduction potential (ORP), temperature, dissolved oxygen (DO), specific conductivity, and turbidity. These probes are contained within one unit and allow for simultaneous measurements to be collected.

The Horiba will be used to monitor the stabilization of key indicator parameters (refer to the USEPA Region 2 "Low Flow Purging and Sampling" guidance document) which will determine when adequate purging of groundwater has occurred and sampling of the well is acceptable. The model U-22 will be fitted with a flow through cell which eliminates the contact of the purge water with air and allows for continuous, undisturbed monitoring of the well water. The model U-10 will be utilized for surface water sampling (including QA/QC sampling of fire hydrant, DI water, and potable tank water supplies) and well development activities.

This SOP will provide guidance for using this instrument during the water investigation activities.

2.0 Materials

a. Horiba U-10 with sample container cup or U-22 with flow through cell (flow through cell connection barbs should match the inner diameter of sample tubing being used).

b. Teflon lined polyethylene tubing (3/8" or ½" ID) for well sampling

c. Horiba Auto Cal solution

d. Calibration cup

3.0 Procedure

3.1 Calibration (Auto Calibration procedure)

3.1.1 The Auto Calibration mode allows for the calibration of the pH, COND, and TURB sensors in the Auto Calibration solution. DO is calibrated in the atmosphere simultaneously. Temperature and ORP are not field calibrated.

3.1.2 Before performing the auto calibration procedure, turn the unit on and allow it to warm up for about a half hour to one hour. This will allow the temperature to stabilize which will minimize unstable values during calibration.

3.1.3 Wash the sensors with distilled water a few times and fill the calibration cup to the marked line with the Auto Calibration solution. Immerse the probe sensors into the calibration solution until the cup snaps securely onto the probe.

3.1.4 Be sure that one of the measurement modes (pH, COND, or TURB) are selected. Press the **CAL** key. **AUTO** and **CAL** appear in the upper portion of the screen and the instrument is now in Auto Calibration mode.

3.1.5 Press the **ENT** key to start the Auto Calibration. During calibration **DATA IN** and the current measurement being calibrated blink. When a measurement is calibrated it stops blinking and remains illuminated.

3.1.6 **END** will be displayed upon the completion of the calibration procedure for all measurements. Press the **MEAS** key to return to the measurement mode.

3.1.7 Press the **MEAS** key to view each of the measurements and record the readings while in the Auto calibration solution.

3.1.8 If an **ERROR** message occurs after calibration refer to the Horiba "Operation Manual" for error explanations and troubleshooting guidance (p. 89)

3.2 Operation

<u>U-22</u>

3.2.1 Connect the flow through cell to the U-22 probe. Be sure that the probe is attached securely to the flow through cell to ensure an air tight seal. Check that barbed fittings are tightly in place. If necessary, re-apply Teflon plumbers tape to the barbed fittings and secure into place.

3.2.2 Connect the end of the tubing from the submersible pump (already installed in the well) to the intake barb of the flow through cell (located on the bottom of the flow through cell). For correct operation the flow through cell must be filled from the bottom up.

3.2.3 Cut a small piece of tubing (approximately 2' to 3') to connect to the discharge barb of the flow through cell (located on the top of the flow through cell). The end of this tubing should be placed into a 5 gallon bucket for containment of the purge water.

3.2.4 Once all tubing connections have been made, secure the probe so that it does not tip over during purging. While purging, movement of the probe should be minimized so as to prevent disturbance of the measurements.

U-10

3.2.5 A sampling container is not provided with the U-10. The calibration cup can not be used for sampling due to the cut-out in the cup that exposes the dissolved oxygen sensor to ambient air for calibration (this sensor would not be exposed to the water sample if the calibration cup were utilized for sampling). Fill a sampling container (e.g., a tupperware container) with enough water to cover all of the sensors – including the dissolved oxygen sensor – when the instrument is placed in the sampling container.

3.2.6 Turn the Horiba U-10 / U-22 on. Proceed with purging as per Field Sampling Protocols. Toggle through the measurements by pressing the **MEAS** key.

4.0 Maintenance

During periods of meter operation, silt and other foreign materials can accumulate on the probes. The turbidity probe is especially susceptible to this due to its small size. The accumulation of these materials may result in erroneous readings. While in use it is not recommended to stop purging and clean the probe. At a minimum, the probe and sensors should be cleaned between each well and at the end of the day before packing the instrument away.

The following items cover basic field maintenance procedures for the Horiba U-22. Maintenance instructions for specific Error Codes can be obtained from the Horiba "Operation Manual." Complicated repairs and sensor replacement should be left to a trained service technician.

4.1 After use in each well, remove the protective cage from around the probe and the protective cover over the turbidity sensor. Using a non-abrasive Alconox wash, rinse the probe and the individual sensors.

4.2 Apply a final rinse using deionized water. Be sure to remove all soapy material.

4.3 The turbidity probe can be further cleaned by gently wiping the two lenses with a clean, damp paper towel.

4.4 Replace the turbidity and probe protective covers.

5.0 Precautions

5.1 The Horiba is designed to monitor groundwater. The instrument (hand held display) is constructed to be water resistant. However, it is good practice to keep the instrument as dry as possible. When working in the rain the instrument should be placed inside a Ziplock baggie.

5.2 The probe is not designed to monitor groundwater containing free product. Free product will likely damage the sensors rendering the unit inoperable. Care should be taken to confirm that no free product will be encountered in the wells to be sampled

5.3 Exposure to direct sunlight can cause the LCD display to deteriorate. Do not expose the instrument to direct sunlight for long periods of time. It is preferable to provide some type of shade when working in direct sunlight conditions.

5.4 Freezing temperatures can cause damage to the instrument sensors. When working in freezing or near freezing conditions, store the instruments in a warm location overnight to avoid damage.

5.5 When storing the instrument the sensors should be kept moist to avoid drying out. Place a small amount of Auto Calibration solution in the calibration cup and place the probe inside the cup.

5.6 Do not drop the instrument or probe. Glass electrodes in some sensors and delicate electronics can easily break if the instrument is grossly mishandled.

6.0 References

Horiba, 1999, U-20 Series Operation Manual

7.0 Attachments

Calibration Form

EXHIBIT

Diamond Head Oil Superfund Site
1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson County)

DAILY EQUIPMENT CALIBRATION RECORD SHEET

EMPLOYEE: ____________________ **LOCATION:** ____________________

DATE: ____________________ **PROJECT NO.:** 173044.FI.FI.07

WEATHER: ____________________

HORIBA U-22

RENTAL CO.: ____________________ **CALIBRATION SOLUTION MFR.:** __________

MODEL NO.: U-22 **CALIBRATION SOLUTION LOT NO.:** __________

SERIAL NO.: ____________________ **CALIBRATION SOLUTION EXP. / MFG. DATE:** __________

CALIBRATION PROCEDURE: AutoCalibrate

pH:	Reading		Units	Std. Units	Standard	4.0 Std. Units
Conductivity	Reading		Units		Standard	4.49 mS/cm
Turbidity:	Reading		Units	NTU	Standard	0.0 NTU
Temperature:	Reading		Units	°C	Standard	N/A
Dissolved Oxygen:	Reading		Units	mg/L	Standard	20.9 mg/L (Ambient Air)
ORP:	Reading		Units	mV	Standard	N/A

COMMENTS: ____________________

CALIBRATION OK: **Y / N**

HORIBA U-10

RENTAL CO.: ____________________ **CALIBRATION SOLUTION LOT NO.:** __________

MODEL NO.: U-10 **CALIBRATION SOLUTION EXPIRATION DATE:** __________

SERIAL NO.: ____________________ **CALIBRATION SOLUTION EXP. / MFG. DATE:** __________

CALIBRATION PROCEDURE: AutoCalibrate

pH:	Reading		Units	Std. Units	Standard	4.0 Std. Units
Conductivity	Reading		Units		Standard	4.49 mS/cm
Turbidity:	Reading		Units	NTU	Standard	0.0 NTU
Temperature:	Reading		Units	°C	Standard	N/A
Dissolved Oxygen:	Reading		Units	mg/L	Standard	20.9 mg/l (Ambient Air)

COMMENTS: ____________________

CALIBRATION OK: **Y / N**

STANDARD OPERATING PROCEDURE
EQUIPMENT DECONTAMINATION

1.0 Scope and Application

All sampling equipment must be decontaminated following each use in order to prevent cross-contamination. This Standard Operating Procedure (SOP) describes the procedures to be followed for decontaminating sampling equipment used during field activities.

This SOP is based on the Region II Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling.

2.0 Materials

a. Plastic sheeting
b. Buckets
c. Presampled and approved water
d. Demonstrated analyte-free distilled and deionized water
e. 10% HNO_3 solution
f. Low phosphate detergent (i.e., alconox)
g. Hexane (pesticide-grade or better)
h. Methanol (optima-grade)
i. Aluminum foil

3.0 Procedure

3.1 Pre-sampled and Approved Water

3.1.1 Two types of water will be used for decontamination:

- Potable water supplied by a vendor to an onsite potable water tank. This water will be treated in an onsite treatment system to produce Type I Deionized (DI) water, which in turn will be used for the decontamination of all sampling equipment.
- Water from a fire hydrant in the neighborhood – the driller will use this source to decontaminate his drilling equipment.

To document the quality of the water used for decontamination, the following samples will be collected at the start of the field activities and analyzed for TCL organics and TAL metals through the CLP:

- One sample and a duplicate will be collected from the potable water tank.

- One sample and a duplicate will be collected from the first batch of Type I DI water produced at the site after it is poured into the bottles for storage. Thereafter, one sample and a duplicate will be collected once per month.
- One sample and a duplicate will be collected from the fire hydrant from where the driller will obtain his water.

3.1.2 The samples from the potable tank and fire hydrant will be collected as follows:

a. Open fire hydrant and let run for 5 minutes (commence immediately on potable tank sampling).
b. Record pH, temperature, turbidity, ORP, DO, and specific conductance immediately prior to sampling.
c. Collect one sample and a duplicate directly from source.
d. Tilt sampling bottles and fill slowly along edge of bottle to avoid cascading and turbulence.
e. Close bottles and place on ice.
f. Close tap/hydrant.

The samples from the DI water produced onsite will be collected directly from a bottle in which the DI water is stored as follows:

1. Record pH, temperature, turbidity, ORP, DO, and specific conductance of water in bottle immediately prior to sampling.
2. Collect one sample and a duplicate directly from storage bottle.
3. Tilt sampling bottles and fill slowly along edge of bottle to avoid cascading and turbulence.
4. Close bottles and place on ice.
5. Close water storage bottle.

3.1.3 If the source(s) changes, collect a sample and a duplicate from the new source(s).

3.1.4 For each lot of Type II DI water brought to the site for use in generation of blank samples, record in the field logbook the type of water, manufacturer, and lot number. Maintain in the project file, the manufacturer's documentation delivered with the water.

3.2 Decontamination of Sample Bottles

At the completion of each sampling activity the sample bottles must be decontaminated as follows:

1. Be sure that the bottle lids are on tight.

2. Wipe the outside of the bottle with a paper towel to remove excess soil or water.

3.3 Decontamination of Sampling Equipment

3.3.1 Non-disposable, Non-electric Sampling Equipment (utensils, shovels, trowels, etc.)

1. Wash and scrub with low-phosphate detergent (e.g., Liquinox)
2. Rinse with potable water
3. Rinse with 10% HNO_3 solution (ultra pure grade) when sampling for inorganics, unless using carbon steel sampling equipment when a 1% nitric acid solution should be used to avoid stripping of metals.
4. Rinse with DI water
5. Rinse with 10% Methanol Solution (optima grade or better)
6. Rinse with DI water (five times the volume of solvent used).
7. Air dry
8. Wrap exposed portions in aluminum foil (shiny side out)

Note that since positive displacement pumps do not actually come in contact with groundwater to be sampled, these pumps will be decontaminated following the above procedure.

3.3.3 **Equipment Used for Water Quality Measurements, Hydrogeologic Testing, Downhole Geophysical Logging, and Other Non Sampling Uses.**

Field instrumentation will be decontaminated between sampling locations by rinsing with DI water after each use.

If visible contamination still exists, a non-phospahte detergent scrub and rinse will be added followed by rinsing with DI water.

3.3.4 **Heavy Equipment and Monitoring Well Construction Materials**

All drilling equipment will be steam-cleaned with a pressure washer prior to use.

Well screens and riser pipe, if not cleaned and fully encased in plastic by the manufacturer, will also be steam-cleaned to remove any cutting oils or soil from shipping.

The equipment will be rested on clean polyethylene sheeting.

Pressurized steam will be used to remove all visible excess material from drill steel, drill bits, the back of the drill rig, and any other parts of the rig which may contact the media under investigation.

If visible contamination still exists on the equipment after the rinse, a non-phosphate detergent scrub will be added, and the equipment thoroughly rinsed again with pressurized steam.

Steam cleaning will be conducted on the decontamination pad, which will be constructed onsite for the field investigation. All water will be collected and transported to the onsite storage tank.

3.3.5 Aqueous Sampling Equipment

<u>Submersible pumps</u>

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, will be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing will be thoroughly decontaminated using the "daily decon" procedures (see below) prior to their initial use and/or installation. For centrifugal pumps, the non-disposable sampling equipment - including the pump, support cable and electrical wires in contact with the sample - will be decontaminated thoroughly each day before use (daily decon). EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled (between-well decon, see ii. below).

Daily Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D. Disassemble pump.

E. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a stiff brush.

F. Rinse pump parts with potable water.

G. Rinse the following pump parts with distilled /deionized water: inlet screen, the shaft, the section interconnector, the motor lead assembly, and the stator housing.

H. Place impeller assembly in a large glass beaker and rinse with a 10% methanol solution.

I. Rinse impeller assembly with potable water.

J. Place impeller assembly in a large glass beaker and rinse with isopropanol.

K. Rinse impeller assembly with DI water.

Between-Well Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D. Final Rinse: Operate pump in a deep basin of DI water to pump out 1 to 2 gallons of this final rinse water.

The Waterra-positive displacement pumps, which do not physically come in contact with the groundwater, will only require a decontamination procedure consisting of a detergent wash and a DI water rinse.

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 Once a piece of equipment has been decontaminated be careful to keep it in such condition until needed.

5.2 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

U.S. EPA Region II Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE
BORING INSTALLATION METHODS AND SOIL SAMPLING: ROTASONIC DRILLING

1.0 Scope and Application

The purpose of this SOP is to specify the equipment, materials, and protocol for the collection of subsurface soil samples using the RotaSonic drilling sampling method. RotaSonic drilling will be the only soil boring and well drilling technique used and will drill to a maximum depth of approximately 50 feet below the ground surface (bgs) for this investigation.

RotaSonic Materials

a. RotaSonic drill rig
b. 4" Sonic sampling barrels and 6", 8", 10", or 12" sonic overdrill barrels
c. 4" Soil Core Plastic Sheathing
d. Soil Boring Logs (provided and completed by CH2M HILL)
e. Photoionization Detector (provided by CH2M HILL)
f. Sample Containers (provided by CH2M HILL)

NOTE: All materials to be provided by CH2M HILL are indicated. Remaining materials are to be provided by drilling CONTRACTOR.

2.0 RotaSonic Procedures and Guidelines

2.1 Decontaminate drill stem and other non-dedicated downhole equipment in accordance with the SOP on Equipment Decontamination.

2.2 Soil sampling and drilling with RotaSonic equipment is a two-step process. First, a 4" diameter core barrel is advanced into the zone of interest to collect a soil core sample. This barrel is 10-feet long, and up to two can be connected in series to retrieve a 4" by 20 ft. core sample. After the 4" diameter soil core barrel has been advanced to the terminal depth of the sample run, a larger diameter drill rod (6", 8", 10" or 12") is advanced over the 4" rod to both ream the hole and dislodge the advanced 4" rod. The 4" rod is then removed from the borehole and the soil core is extruded from the barrel into plastic sheathing for examination by the site geologist. The larger diameter rod also acts as temporary casing supporting the borehole from collapse while the 4" rod is removed from the borehole. The sequence is repeated to collect the next length of soil core.

2.3 Each time a soil core is extracted, record the depth interval bgs of the core and review the sampling plan and SOP on subsurface soil sampling in order to determine the depth intervals to be sampled.

2.4 Following retrieval of a plastic sheathed soil core, cut the plastic open with a sharp, decontaminated knife parallel to its length to expose the core. The 4 inch diameter soil core can then be broken open to expose a fresh soil surface. Observe the core, screen it with a PID and collect soil samples from the pre-determined intervals(s) following the SOP on Subsurface Soil Sampling. Record lithological information for preparation of a soil boring log (see attached example soil boring log).

2.5 Upon completion of a soil boring, construct a monitoring well or backfill the boring in accordance with the SOPs on Monitoring Well Design and Construction and Borehole Abandonment.

2.6 A site geologist will be present during all well drilling and installation activities and will fully describe and record all tasks performed in support of these activities in the field logbook. The site geologist will be responsible for the rig, including: the logging of samples, monitoring of drilling operations, recording of water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures of the rig.

2.7 Decontamination of all well installation equipment and materials will be carried out as described in the SOP on Equipment Decontamination.

2.8 Petroleum jelly, teflon tape, or lithium grease shall not be used on the threads of downhole drilling equipment. If a lubricating agent is required, the proposed lubricant MUST be reviewed for approval by the site geologist. Adequate time and information, such as Material Safety Data Sheets (MSDS), must be provided for the geologists review. Time spent for on-site review of the proposed material will be considered Down Time and will not be billable by the drilling contractor. Food grade vegetable oil is an example of an approved lubricant. Additives containing either lead or copper will not be allowed. In addition, polychlorinated biphenyls (PCBs) will not be contained in hydraulic fluids or other fluids used in the drilling rig, pumps, or other field equipment and vehicles. MSDS sheets must be available for all such fluids.

2.9 Surface runoff or other fluids will not be allowed to enter any boring or well during or after drilling/construction. Likewise, re-circulated drilling fluids will be contained in the work area during installation of borings and not allowed to runoff into the surrounding areas.

2.10 Antifreeze used to keep equipment from freezing will not contain rust inhibitors and sealants. If the antifreeze is added to a piece of machinery in contact with drilling fluid, the antifreeze will be completely purged from the equipment prior to use in drilling, mud mixing, or any integral part of the overall drilling operation. The contractor will note in the boring log, the following information in regard to the use of antifreeze: date, reason, quantities, and brand name. MSDS sheets will be available for review by the site geologist.

2.11 Screening of the breathing air in the vicinity of the borehole will be conducted at regular intervals using a PID. An aerosol dust meter will be used to monitor the concentration of particulate matter in the air during drilling.

2.12 Proceed to the next drilling location after decontamination of all downhole equipment, including the working surfaces of the drill rig.

2.13 Complete the Daily Activity Drilling Record to document all quantities for the drilling subcontract.

3 Collection and Disposal of Drill Cuttings

3.1 The drilling contractor will be responsible for containerizing all drill cuttings and other wastes generated by the drilling. Cuttings from the investigation locations will be placed into fifty-five gallon, open top, type 17E (1A2) DOT-approved drums. The contractor will transport all drums to an area designated for the storage of wastes within the site.

4.0 Maintenance

Not applicable

5.0 Precautions

1. Verify that the drill rig is clean and in proper working order.
2. Ensure that the drill rig operators thoroughly complete the decontamination process between sampling locations.
3. Use caution to ensure that soil core sections are oriented the correct way (top vs. bottom) when observing lithology and collecting samples.
4. Verify that the borehole made during sampling activities has been properly backfilled or abandoned.

6.0 References

None.

7.0 Attachments

Exhibit 1 Example Boring Log
Exhibit 2 Drilling Activity Daily Report

CH2MHILL

PROJECT NUMBER	BORING NUMBER
173044.FI.FI.07	SHEET OF

SOIL BORING LOG

PROJECT : Diamond Head Oil Superfund Site LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson C

ELEVATION : DRILLING CONTRACTOF

DRILLING METHOD AND EQUIPMENT USED : Versa Sonic V-100 Sonic Rig, 4" x 10' soil core, 6"/8"/10" override casing

WATER LEVELS : START : END : LOGGER : J. Loeffel

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID (ppm): Breathing Zone Above Hole

SOP 10 - Exhibit 1 Soil Boring Log.xls \ Soil Boring -Sonic (No SPT)

DAILY DRILLING ACTIVITY SUMMARY

Project: Diamond Head Oil Superfund Site, 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

Day/Date: **Work Cycle #:** **Lab CASE #** **Project #:** 173044.

Weather:

I. Drilling company:

II. Drilling equipment on site:

A.

B.

C.

D.

E.

F.

III. Drilling personnel on site:

A.

B.

C.

D.

E.

F.

IV. Borings (specify rig & footage for each boring):

A.

B.

C.

D.

E.

V. Coring (specify boring & footage):

A.

B.

C.

D.

E.

VI. Monitoring wells constructed (specify screen interval):

	Well	Total Depth	Screen
A.			
B.			
C.			
D.			
E.			

VII. Development (specify gallons purged):

	Well	Gallons
A.		
B.		
C.		
D.		
E.		

VIII. Comments (standby time, down time, visitors, other site activity, etc.):

____

____

____

____

____

____

Inspected by: ______________________________

STANDARD OPERATING PROCEDURE
BOREHOLE ABANDONMENT

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the protocols for abandoning boreholes after soil and groundwater sampling is completed.

This SOP is based on the technical requirements described in the NJDEP guidance document "Field Sampling Procedures Manual (May 1992)" and N.J.A.C. 7:9D – Well Construction; Maintenance and Sealing of Abandoned Wells (Sept. 4, 2001).

2.0 Materials

a. Drill rig and associated equipment (pressure pump, grout mixer, tremie pipe, etc.)

b. Photoionization Detector (PID)

NOTE: All materials to be provided by CH2M HILL are indicated. Remaining materials are to be provided by drilling contractor.

3.0 Procedure

3.1 Upon completion of the boring and all subsurface sampling, the boring will either be converted into a monitoring well, piezometer, or sealed in accordance with this SOP.

3.1.1 Soil borings will be backfilled with native soil, if the boring has not advanced to a depth of greater than 25 ft below ground surface.

3.1.2 If the boring is advanced greater than 25 ft in depth, or the available soil cuttings do not adequately fill the borehole to be flush with the ground surface, the borehole will be grouted to the surface. A mixture in the ratio of 94 pounds of Portland Type II neat cement, to 6-8 pounds bentonite, to 8-10 gallons of water will be pumped into the boring, under pressure, through a tremie pipe of adequate length such that it discharges at the bottom of the boring. The tremie pipe will be retrieved while pumping the sealing material through it. The sealing material will be pumped into the boring until all of the water in the boring has been displaced, and the sealing material overflowing the boring is of the same density and consistency as the sealing material being pumped into the boring. Although all installed piezometers will not exceed 25 ft in depth, all shall be abandoned by removal of or splitting in place the PVC casing and screen, and grouting to the surface.

3.1.3 After 24 hours, the drilling subcontractor shall check the abandoned borehole for grout settlement. Any settlement depression shall be filled with additional grout and rechecked 24 hours later.

3.1.4 For each borehole, the grouting activities shall be described in the rig geologist's bound notebook, including the date, the time, the quantities and types of materials used to mix the grout, and the quantity of grout pumped into the borehole.

4.0 Maintenance

Not Applicable.

5.0 Precautions

Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

NJDEP, 1992. NJDEP Field Sampling Procedures Manual

NJDEP, 1994. Alternative Ground Water Sampling Techniques Guide

N.J.A.C. 7:9D – Well Construction; Maintenance and Sealing of Abandoned Wells (Sept. 4, 2001).

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE MONITORING WELL AND PIEZOMETER DESIGN AND CONSTRUCTION

1.0 Scope and Application

This Standard Operating Procedure (SOP) provides technical guidance for the installation of permanent groundwater monitoring wells and piezometers at the Diamond Head Oil Superfund Site. This SOP also provides a list of the materials that will be used in the design and construction of the monitoring wells and piezometers.

The actual depth of the monitoring wells and piezometers will depend on the encountered subsurface conditions. Two subsurface intervals are targeted for the groundwater investigation. **Shallow wells** and **piezometers** will be installed above the peat layer, located at approximately 15-20 feet below ground surface (bgs), and will be screened both across the water table and down to the top of the peat layer. These wells will evaluate the potential presence of light non-aqueous phase liquids (LNAPLs) floating on the water table and dense non-aqueous phase liquids (DNAPL) retarded by the change in permeability of the peat layer. **Deep monitoring wells** will be installed below the peat layer, to an approximate depth of 50 feet bgs, and will target the unconsolidated soil interval underlying the peat layer. The deep wells will be installed as double cased wells, with permanent isolation casing installed through the overburden and into the peat layer. Following installation of a smaller diameter pilot hole (4"/6" sonic casings) for lithologic sampling, the borehole will be logged using a downhole natural gamma tool. The boring will then be reamed for the isolation casing and final well installation. The ground water elevation is at approximately 2 feet bgs at the site. All wells and piezometers will have above ground, or "stick-up" casing completions.

This SOP is based on the technical requirements described in the New Jersey DEP guidance document "Field Sampling Procedures Manual" (May 1992), the New Jersey "Technical Requirements for Site Remediation (N.J.A.C. 7:26E, May 1997)" and N.J.A.C. 7:9D – Well Construction; Maintenance and Sealing of Abandoned Wells (Sept. 4, 2001).

2.0 Equipment and Materials Required

a. Drill rig
b. 8-inch diameter, flush threaded, carbon steel isolation casing
c. Natural Gamma downhole geophysical survey equipment
d. Flush-threaded, 2-inch diameter, Schedule 40 PVC riser pipe (piezometers)

e. Flush-threaded, 2-inch diameter, Schedule 40 PVC well screen with factory machined 0.020 inch diameter (20-slot) slotting (piezometers)
f. Flush-threaded, 4-inch diameter, Schedule 40 PVC riser pipe (monitoring wells)
g. Flush-threaded, 4-inch diameter, Schedule 40 PVC well screen with factory machined 0.020 inch diameter (20-slot) slotting (monitoring wells)
h. Feeler gauge to verify screen slot diameter (provided by CH2M HILL)
i. Portland Type I *or* Type II neat cement
j. Certified granular and ¼-inch coarse bentonite (acetone free)
k. Pre-sampled and approved water
l. Certified clean silica sand (Global #5, FilPro #00N, or equivalent)
m. Expanding compression caps (water tight)
n. Keyed-alike brass locks
o. Stick-up, cylindrical, outer protective steel casing with lockable cover
p. ½ of a clean, 55-gallon drum per location (concrete pad form)
q. Water Level Indicator/ Interface Probe (provided by CH2M HILL)
r. Weighted tape
s. Well Construction Diagram (provided and completed by CH2M HILL)

NOTE: All materials to be provided by CH2M HILL are indicated. Remaining materials are to be provided by drilling contractor.

3.0 Procedure

3.1 Monitoring Well and Piezometer Borehole Drilling

3.1.1 RotaSonic drilling methods will be used to advance the borehole for installation of groundwater monitoring wells and piezometers. The borehole diameter must be a minimum of 4-inches greater than the diameter of the well construction material (e.g.; 2" piezometer requires a nominal 6" borehole, 4" well requires a nominal 8" borehole, 8" isolation casing requires a nominal 12" borehole). All water used for drilling must be pre-sampled and approved by CH2M HILL.

3.1.2 Details regarding borehole drilling for the installation of monitoring wells and piezometers is provided in the SOP for Borehole Installation. Additional details on the installation of the permanent isolation casings for the deep monitoring wells is provided below.

Double Cased Wells (Deep Monitoring Wells)

3.1.3 The deep monitoring wells, which will be installed below the peat layer, will be constructed as double cased wells with permanent isolation casing through the overburden materials and into the peat layer.

To facilitate the collection of all desired data, the drilling sequence for deep monitoring wells will be as follows:

- Drill a boring to 50 feet bgs to collect lithologic samples using the 4-inch and 6-inch sonic drill casing.
- Remove the 4-inch sonic core barrel and perform the downhole geophysics survey with the gamma log tool to 50 feet bgs through the 6-inch sonic casing.
- Remove the 6-inch sonic casing from the boring and ream the boring to the appropriate depth for installation of the permanent 8-inch diameter steel isolation casing with 12-inch sonic drill casing. Removing the 6-inch sonic casing first will allow drill cuttings to fill the pilot hole.
- Install the permanent 8-inch diameter steel isolation casing as described below. Some grout will enter the pilot hole.
- Ream the borehole to 50 feet bgs with nominal 8-inch drill casing, removing all drill cuttings and fugitive grout materials.
- Construct the 4-inch diameter monitoring well at 50 feet bgs.

The field geologist will notify the drill crew of the depth at which the peat layer is encountered based on observations of soil core samples. When instructed by the field geologist, an 8-inch diameter steel isolation casing will be installed in a 12-inch diameter boring into the peat layer. In accordance with N.J.A.C. 7:9D-2.2;20(b)1, the isolation casing will be installed either 20-feet into the peat layer or to the bottom of the peat unit, whichever is encountered first.

Once the 12-inch diameter borehole drilling has reached the proper depth for installation of the 8-inch diameter steel isolation casing, the isolation casing will be constructed inside the RotaSonic override drill casing. The isolation casing will be permanently grouted into place using a straight Portland Cement mix. The grout will be pressure pumped through the center of the steel isolation casing, forcing the grout to the ground surface by way of the annular space between the isolation casing and borehole/12-inch RotaSonic drill casing. The bottom portion within the isolation casing will also be sealed with grout. The 12-inch diameter RotaSonic override drill casing will be withdrawn from the borehole in stages as the grout mixture is added.

The grout mixture will be allowed to stand for a minimum of 24 hours before drilling resumes. Prior to resuming drilling, the field geologist will measure the depth inside the isolation casing with a tag line to verify that a competent seal has been formed and the grout has not seeped into the formation (i.e.; if a 25 foot isolation casing was installed, the depth measured inside the steel isolation casing should be less than 25 feet due to the presence of solidified grout inside the casing).

Advancement of a nominal 8-inch diameter borehole will continue through the steel isolation casing for the installation of a 4-inch diameter monitoring well. The screened interval for the deep monitoring wells will be the bottom 10 or 20 feet of the borehole, as determined by the field geologist based on the observed transmissivity of the subsurface material (highly transmissive materials will receive a 10-foot long well screen and low transmissivity materials will receive a 20-foot long well screen).

3.2 Monitoring Well (Specific) Materials Specifications

3.2.1 Overburden monitoring wells (shallow and deep) will be constructed of flush-threaded, 4-inch diameter (nominal size), Schedule 40 PVC casing, that conforms to the National Sanitation Foundation Standard 14 for potable water usage. No PVC solvents or glues will be used.

3.2.2 Well screens for the overburden monitoring wells (shallow and deep) will consist of flush-threaded, 4-inch diameter (nominal size), Schedule 40 PVC with factory machined 0.020 inch size screen slotting (20-slot). All screens will have a flush threaded bottom cap.

The screen length for the shallow wells will be 20-feet, enabling the wells to be screened across the water table and to the top of the peat. The 20-foot screen lengths for the shallow wells will enable both the determination of LNAPL thickness floating on the water table and observations for DNAPL above the peat, if any is noted.

The screen lengths for the deep monitoring wells will be either 10- or 20-feet, and will be determined in the field for each well based on observations of the geologic cores obtained during the drilling of the well boring. Specifically, if low transmissivity materials are observed in the core at the depth at which the deep well screen is planned, the well will be constructed using a 20-foot screen length. If higher transmissivity materials are observed at that depth, then a 10-foot screen length will be used. While some indication as to the appropriate screen length will be available at the first deep well location, the actual screen length at each location will be determined based on the specific lithologic information obtained at that location.

3.2.3 Certified clean silica sand (Global # 5, FilPro # 00N or equivalent compatible with 20-slot well screen) will be used in the gravel pack around the well screen and will be compatible with both the screen slot size and aquifer materials.

3.3 Piezometer (Specific) Materials Specifications

3.3.1 Piezometers will be constructed of flush-threaded, 2-inch diameter (nominal size), Schedule 40 PVC casing, that conforms to the National Sanitation Foundation Standard 14 for potable water usage. No PVC solvents or glues will be used.

3.3.2 Well screens for the piezometers will consist of flush-threaded, 2-inch diameter (nominal size), Schedule 40 PVC with factory machined 0.020 inch size screen slotting (20-slot). All screens will have a flush threaded bottom cap.

3.3.3 Certified clean silica sand (Global # 5, FilPro # 00N or equivalent compatible with 20-slot well screen) will be used in the gravel pack around the well screen and will be compatible with both the screen slot size and aquifer materials.

3.4 Monitoring Well & Piezometer Materials Specifications

3.4.1 All screens, casing, and fittings will be in factory sealed protective wrapping or will be decontaminated at the site and wrapped in plastic sheeting until installed.

3.4.2 Commercially available, certified (acetone free), ¼-inch coarse bentonite (chips) will be hydrated to make a bentonite seal.

3.4.3 Grout consisting of a mixture in the ratio of 94 lbs. of Portland Type I or Type II neat cement, to 4-6 lbs. granular bentonite, to 7-9 gallons of water will be used to grout the annular space between the casing and the open borehole (target density 13.9 lbs/gal). Neither additives nor borehole cuttings will be mixed with the grout. Bentonite will be added after the required amount of cement is mixed with the water.

All grout material will be combined in an above-ground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout will be re-circulated through a grout pump prior to placement.

3.4.4 A water-tight, compression/expansion lockable cap with keyed-alike locks will be placed on top of the riser in each stick-up well.

3.4.5 Well head completions will be constructed with a cylindrical steel protective casing with a lockable cover. The casing will be set within ½ of a clean, 55-gallon drum that will be used as a well pad construction form.

3.5 Installation of Shallow and Deep Monitoring Wells and Piezometers

3.5.1 When a monitoring well boring is completed, the site geologist will visually inspect the hole and decide on the depth of the well. All well installations will begin within 48 hours of boring completion, and, once begun, will continue uninterrupted until completed. If necessary, the bottom of the borehole will first be backfilled to the desired depth. Bentonite grout will be used to backfill the borehole to within 5 feet of the desired screen depth. This remaining 5 feet will be backfilled with certified clean silica sand (Global #5, FilPro # 00N or equivalent) to prevent grout from fouling the screen.

3.5.2 Once the drilling has reached the proper depth for well installation, the PVC monitoring well will be constructed inside the RotaSonic override steel casing. The permanent monitoring wells will be constructed (placement of sand filter pack, bentonite seal, and bentonite cement grout) inside the drill casing as the drill casings are gradually removed to allow for proper placement of well construction materials.

3.5.3 Assemble appropriate lengths of casing and screen. Make sure these are clean and free of grease, soil, and residue.

3.5.4 Lower each section of PVC and screen into the borehole, one at a time, threading each section securely (this may require the use of a strap wrench or equivalent). Threaded couplings must be joined to form a flush fitting that engages the Buna-N o-ring gasket.

3.5.5 Cap the top of the PVC casing after the well is installed to ensure that material does not enter the well. A temporary slip cap may be used through the remainder of the well construction process.

3.5.6 Install the gravel pack material (Global # 5, FilPro # 00N or equivalent sand for 20-slot screen) with the gravity feed method around the well screen to a minimum height of approximately 2 feet above the top of the well screen. The sand will be added at a rate slow enough such that bridging of the sand will not occur. Gravel pack depth will be continuously monitored and tamped with a weighted tape during installation to ensure bridging does not occur.

3.5.7 After the gravel pack is in place, wait ten minutes for the material to settle. If necessary, add more gravel pack to bring the material to a level of 2 feet above the top of the well screen.

3.5.8 A bentonite seal will be placed above the gravel pack. The seal will consist of certified (acetone free) ¼-inch, coarse bentonite (chips) gravity fed into the borehole at a rate slow enough such that bridging of the chips will not occur. A sufficient volume of bentonite will be used to provide a minimum of a 2-ft bentonite seal.

3.5.9 Allow the bentonite to set-up for a minimum of 20 minutes.

3.5.10 With a mechanical mixer, mix an approximate grout-cement slurry as described in Section 3.4.3

3.5.11 Pressure pump the grout-cement slurry into the annulus using a tremie pipe. The pipe should be withdrawn as the slurry is added. The grout-cement slurry should extend from the top of the bentonite seal to a depth of approximately one foot below ground surface.

3.5.12 After the grout-cement slurry has set (approximately 24 hours), check the grout for settlement and add additional grout to fill any subsidence, if necessary.

<u>Note: Shallow Well and Piezometer Annular Construction</u>

It is anticipated that the construction of the shallow monitoring wells and piezometers may require modification from the conventional procedures, listed above, due to the shallow occurrence of the water table at approximately 2 feet bgs and the resulting short length of well riser material. The well construction design will be modified to accommodate the desired screen interval and limited annular space available to construct the annular seal and grouting associated with a

conventional monitoring well design. In these instances, the well will be completed through procedure 3.5.7 above, during which the well screen gravel pack sand will extend to 1 foot above the well screen, and a hydrated granular bentonite seal, at least 1 foot thick, will then be installed above the annular gravel pack. The Portland Cement – Bentonite grout mixture will be omitted from the well construction process. Well head completion will be installed as described below.

3.5.13 Well head completion will consist of a cylindrical steel protective casing installed over the PVC well casing and set in a concrete pad. The concrete pad will be constructed using one-half of a clean 55-gallon drum as a form and filled with concrete (approximately 4 cubic feet), with the well centered in the middle of the pad. The pad should slope from the well in the center, outward and down so that it directs drainage away from the well.

3.5.14 Following completion of the monitoring well installation activities, the NJDEP monitoring well permit number will be steel-stamped onto the steel cover.

3.5.15 The driller will be responsible for obtaining all necessary permits for the installation of the wells. Following completion of construction of the wells, CH2M HILL will prepare a well construction diagram for each well. The diagram will be attached to the boring log and will graphically denote the following, if applicable:

Bottom of the boring
Screen location
Permanent Isolation Casing Location
Gravel filter pack
Bentonite Seal
Grout
Depth of riser below the surface
Protective Surface Casing

4.0 Maintenance

None

5.0 Precautions

Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

NJDEP, 1992. Field Sampling Procedures Manual.

N.J.A.C. 7:26E, May 1997. "Technical Requirements for Site Remediation"

N.J.A.C. 7:9D, Sept. 4, 2001. Well Construction; Maintenance and Sealing of Abandoned Wells

7.0 Attachments

Well Construction Diagram - stick-up construction
Well Construction Diagram - stick-up double cased construction

CH2MHILL

PROJECT NUMBER	BORING NUMBER
173044.FI.FI.07	SHEET 1 OF 1

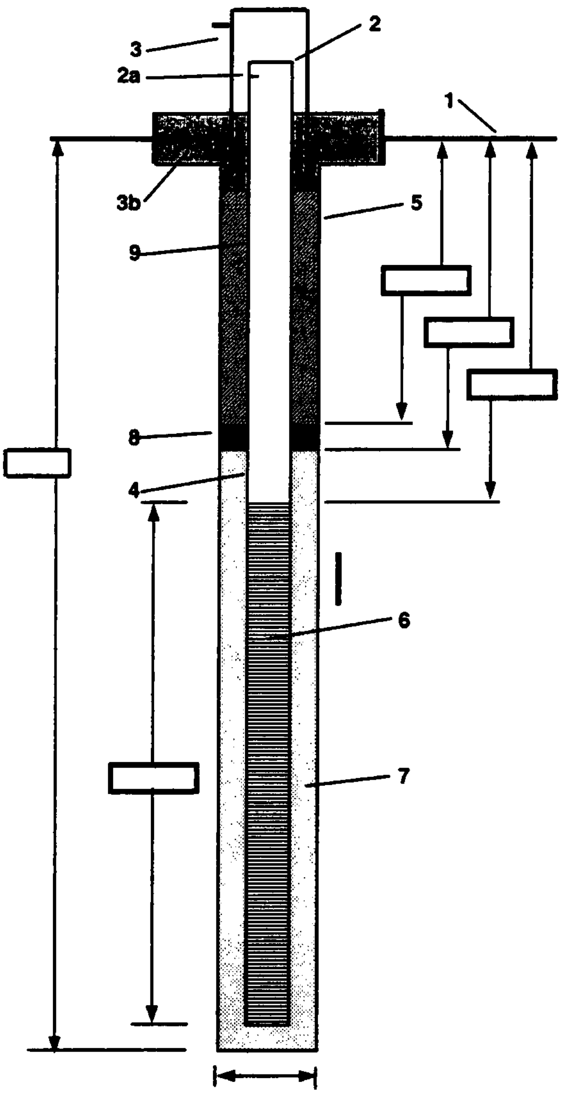
WELL COMPLETION DIAGRAM

PROJECT Diamond Head Oil Superfund Site - Phase 1 LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :



Well Borehole Dia.

1- Ground elevation at well

2- Top of Well Casing elevation
a) vent hole?

3- Wellhead protection cover type
b) concrete pad dimensions

4- Diameter/type of well casing

5- Diameter/type of isolation casing NONE

6- Type/slot size of screen

7- Type screen filter
a) Quantity used

8- Type of seal
a) Quantity used

9- Grout
a) Grout mix used
b) Method of placement
c) Quantity of well casing grout

Development method

Development time

Estimated purge volume

Comments

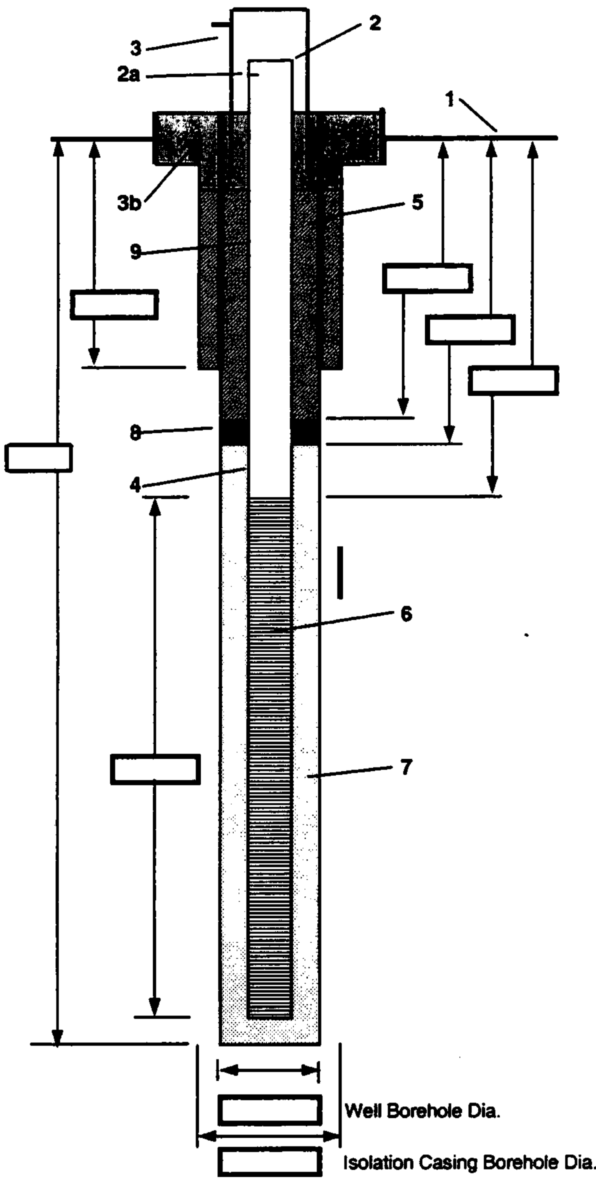
NJDEP Well Permit #

PROJECT NUMBER	BORING NUMBER
173044.FI.FI.07	SHEET 1 OF 1

CH2MHILL

WELL COMPLETION DIAGRAM

PROJECT Diamond Head Oil Superfund Site - Phase 1 LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)
ELEVATION : DRILLING CONTRACTOR :
DRILLING METHOD AND EQUIPMENT USED :
WATER LEVELS : START : END : LOGGER :



1- Ground elevation at well ____

2- Top of Well Casing elevation ____
a) vent hole? ____

3- Wellhead protection cover type ____
b) concrete pad dimensions ____

4- Diameter/type of well casing ____

5- Diameter/type of isolation casing ____

6- Type/slot size of screen ____

7- Type screen filter ____
a) Quantity used ____

8- Type of seal ____
a) Quantity used ____

9- Grout
a) Grout mix used ____
b) Method of placement ____
c) Quantity of isolation casing grout ____
d) Quantity of well casing grout ____

Development method ____

Development time ____

Estimated purge volume ____

Comments ____

NJDEP Well Permit # ____

- Five well volumes have been purged (including the saturated filter material in the annulus) plus the volume of water added during the drilling process (if any) have been removed from the well, regardless of stabilization of the water quality parameters.

CH2M HILL field personnel will measure and record water quality parameters and make the determination on when well development is complete.

3.2 Collection and Disposal of Development Water.

3.2.1 The drilling contractor will be responsible for containerizing development water in a portable tank and for transporting it to a 21,000-gallon on-site storage tank. CH2M HILL will arrange for the disposal of the containerized well development water along with any other IDW water.

4.0 Maintenance

4.1 The water quality meter should be maintained in accordance with the manufacturer's instructions.

5.0 Precautions

5.1 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

USEPA – Office of Solid Waste and Emergency Response, March 1992, Ground Water Forum: Monitoring Well Development Guidelines for Superfund Project Managers.

USATHAMA, 1987. Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition, and Reports. March 1987.

7.0 Attachments

Well and Piezometer Development Form

PROJECT NUMBER	WELL NUMBER
173044.FI.FI.07	SHEET 1 OF 1

CH2MHILL

WELL DEVELOPMENT LOG

PROJECT : Diamond Head Oil Superfund Site LOCATION: 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)

Development Contractor:

START Time: END Time : LOGGER :

Diameter of Well (inches) & Type:

Depth of Well (feet):

Depth to Water (feet)

Water Column Height (feet):

Gallons per Foot:

One Well Volume (gallons):

Five Well Volumes (gallons):

Development Method:

Surge Block Used:

Screen Interval Surged:

Water Quality Meter (Manufacturer/Model/Serial #):

Maximum Drawdown During Pumping:

Average Discharge Rate & Range:

Total Quantity of Water Discharged:

Disposition of Discharge Water:

Dia. (in)	Gal./Ft.	Dia. (in)	Gal./Ft.
1"	0.041	5"	1.02
2"	0.163	6"	1.469
3"	0.367	8"	2.611
4"	0.653	10"	4.08

Time	Water Volume Discharged (gal)	Water Level (ft BTIC)	Turbidity (NTU)	Temperature (°C)	pH (Std. Units)	Conductivity (μmhos/cm)	Remarks (color, odor, sheen, sediment, etc.)

Comments:

NJDEP Well Permit #

STANDARD OPERATING PROCEDURE
MONITORING WELL AND PIEZOMETER DEVELOPMENT

1.0 Scope and Application

This Standard Operating Procedure (SOP) provides technical guidance for the development of permanent groundwater monitoring wells and temporary piezometers. This SOP also provides a list of the equipment that will be used in the development of the monitoring wells and piezometers.

This SOP is based on the US EPA's Ground Water Forum guidance document "Monitoring Well Development Guidelines for Superfund Project Managers", March 1992.

2.0 Materials

a. Drill rig
b. Photoionization Detector (PID) (provided by CH2M HILL)
c. Combustible Gas Indicator (CGI) (provided by CH2M HILL)
d. Water Level Indicator (provided by CH2M HILL)
e. Submersible pump; Redi-flow 2 or equivalent
f. Horiba® U-10 / U-22 or similar instrument for measuring pH, temperature, conductivity, and turbidity (provided by CH2M HILL)
g. Polyethylene tubing (does NOT have to be Teflon lined)
h. Portable polyethylene tank or other large container for well development water
i. Surge Block for shallower wells
j. Well Development Form (provided and completed by CH2M HILL)

NOTE: All materials to be provided by CH2M HILL are indicated. Remaining materials are to be provided by drilling Contractor.

3.0 Procedure

3.1 Monitoring Well and Piezometer Development

3.1.1 Development will begin no sooner than 48 hours, but no later than seven days after construction of the well and surface completion.

3.1.2 Development of groundwater monitoring wells will be recorded on the attached Well Development Form. The following data will be recorded for development:

- Well designation

- Date of well installation
- Date of development
- Static water level before development
- Quantity of standing water in well prior to development
- Conductivity, temperature, pH, and turbidity measurements will be taken during each consecutive well volume purged
- Depth from top of well casing to bottom of well
- Screen length
- Depth from top of well casing to top of sediment inside well, before and after development
- Physical character of removed water, including changes during development in clarity, color, particulate matter, and odor
- Type and size/capacity of pump and/or bailer used
- Description of surge technique, if used
- Height of well casing below ground surface
- Quantity of water removed and removal time

3.1.3 Development will be by pumping the groundwater with a stainless-steel electric-powered submersible pump. The submersible pump intake will be placed within the screened interval of the well/piezometer. Initially, the pump will be placed approximately 1 foot above the bottom of the well/piezometer, and later moved to the middle and top portions of the screen. The pump will be surged to facilitate the removal of fine sediments from the well/piezometer.

3.1.4 Polyethylene tubing, connected to the pump with stainless-steel clamps, will be used for purging . New tubing will be attached to the pump for each monitor well or piezometer and will be disposed of after use. Teflon lined tubing will not be required for development.

3.1.5 Water will not be added to the well/piezometer to aid in development, nor will any type of air-lift technique be used.

3.1.6 Development will proceed until one of the following conditions are met and the sediment thickness remaining in the well/piezometer is less than five percent of the screen length (e.g.: 6 inches of sediment in a 10 foot screen):

- Stabilization of water quality parameters. Stabilization will be defined as less than 10 percent variance between the removal of two successive well volumes. Turbidity measurements are the most critical development criteria, with a target level of 5 NTUs or lower.

STANDARD OPERATING PROCEDURE WATER LEVEL, THICKNESS OF PRODUCT, AND WELL- DEPTH MEASUREMENTS IN CONVENTIONAL WELLS and Piezometers

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the protocol for measuring water level, thickness of LNAPL, and well-depths in the conventional monitoring wells and piezometers at the site. In this SOP, the term well is used to designate both wells and piezometers.

2.0 Materials

a. Water-level/ Interface Indicator with cable measured at 0.01 foot increments
b. Plastic sheeting
c. Folding ruler or pocket steel tape
d. Field logbook
e. Photoionization detector (PID)
f. Squirt bottle with DI water and paper towel

3.0 Procedure

3.1 Preliminary Steps

3.1.1 Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing.

3.1.2 Remove the well cap and check for organic vapors using a PID.

3.1.3 Locate and record the specified benchmark or survey point for the well, which may be a mark at the top of the casing or surveyors pin embedded in the protective structure. Determine from the records and record in the field logbook the elevation of this point. Measure and record the vertical distance from the bench mark to the top of the well casing, to the nearest 0.01 feet. Measure and record the metal casing stick-up (the distance between the top of the casing and nominal ground (level).

3.1.4 Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.

3.1.5 Keep all equipment and supplies protected from contamination. Keep the water level indicator probe in its protective case when not in use.

3.2 Operation

3.2.1 Remove the water level indicator probe from the case, turn on the sounder, and test check the battery and sensitivity scale by pushing the red button. Adjust the sensitivity scale until you can hear the buzzer.

3.2.2 Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter just begins to buzz. Marking the spot by grasping the cable with the thumb and forefingers at the top of the casing, withdraw the cable and record the depth.

In the instances where LNAPL is present, the interface probe will intermittently beep at the top of the product.

Record this depth in the field logbook and record form.

Continue to lower the probe until the solid buzz is heard, which is the water level/ LNAPL interface. Record this depth in the field logbook and record form .

3.2.3 To measure the well depth, lower the probe until slack is noted in the cable. Very slowly raise and lower the cable until the exact bottom of the well is "felt." Measure and record the depth. Note that there is a protective tip on the sonde between the electrical sensor and tip of the probe. The length of this protective tip must be added into the total measured length when measuring well depth.

3.2.4 Withdraw the cable and probe, and decontaminate.

3.3 Data Recording and Manipulation

Record the following computations:

casing elevation = bench mark elevation + casing stick-up
top of product elevation = casing elevation - depth to product
thickness of product = depth to water – depth to product

water level elevation = casing elevation - depth to water
well bottom elevation = casing elevation - depth to bottom

4.0 Maintenance

4.1 Check the batteries of the water level/interface indicator each time the instrument is used.

5.0 Precautions

5.1 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

None.

7.0 Attachments

Water level and product thickness measurement record.

SOP 14 - Exhibit
Water Levels and LNAPL Product Thickness Measurements

Well ID No.	Date (mm/dd/yyyy)	Time (enter in 24-hr time format; 13:00)	Top of Inner Casing Elevation (feet)	Depth to Top of Product from BTIC (feet)	Depth to Bottom of Product from BTIC (feet)	Depth to Water from BTIC (feet)	Product Thickness (feet)	Water Level Elevation (feet)	Top of Product Elevation (feet)	Depth to Bottom of Well (feet bgs)	Well Bottom Elevation	Well Head PID Readings (ppm)	Comments, Product Description

STANDARD OPERATING PROCEDURE
LOW STRESS (LOW FLOW) GROUNDWATER PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLS, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

Note: This procedure applies to the collection of groundwater samples from the conventional monitoring wells at the site. A separate procedure describes the protocol to follow in collecting samples from the Westbay wells.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i. E., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include: a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i. e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator ParametersError! Bookmark not defined.

If one or more key indicator parameters fails to stabilize after 4 hours, one of three options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i. e., 1/4 or 3/8 inch ID) to ensure that tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.
- Well construction data, location map, field data from last sampling event.
- Polyethylene sheeting.
- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).
- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.
- Interface probe or equivalent device for determining the presence or absence of NAPL.
- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.
- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).
- Power source (generator, nitrogen tank, etc.)
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

- Decontamination supplies (see Section VII, below).
- Logbook (see Section VIII, Below).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-out or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the desired depth in the well. For wells with screens longer than 10 feet, the pump may be positioned at any one of the following depths: the portion of the screen of interest, the portion of the screen with the highest yield, or as a default at the middle of the screened interval. The pump intake will be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. The field geologist will record the depth to which the pump is lowered and the rationale used in selecting this depth.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200-500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    - 0.1 for pH
    - 3% for specific conductance (conductivity)
    - 10 mv for redox potential
    - 10 % for DO and turbidity

13. Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

14. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

15. Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

16. Remove Pump Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

17. Measure and record well depth.

18. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The frequency of collecting field quality control samples is provided in Section 8 of the SAP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates (collect native sample and then immediately collect duplicate sample)
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest levels of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon" see below).

Daily Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D. Disassemble pump.

E. Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F. Rinse pump parts with potable water.

G. Rinse the following pump parts with distilled /deionized water: inlet screen, the shaft, the section interconnector, the motor lead assembly, and the stator housing.

H. Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HN03).

I. Rinse impeller assembly with potable water.

J. Place impeller assembly in a large glass beaker and rinse with acetone.

K. Rinse impeller assembly with distilled/deionized water.

Between-Well Decon

A. Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B. Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Liquinox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C. Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D. Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. Complete the attached forms. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

VIIIA. ADDITIONAL DOCUMENTATION

Refer to SOP on Field Parameter Forms for forms to use on documenting the performed sampling. These forms include:

- Sampling Log
- Sample Log Sheet
- Low-Flow Sampling Data Sheet

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R. W. and M. J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93 001.

U.S. EPA Region II, 1989, CERCLA Quality Assurance Manual.

X. ATTACHMENTS

Low Flow Purge Sampling Form

Low-Flow Groundwater Sampling: Field Data Sheet

Well Number:	**Site:** Diamond Head Oil Superfund Site / 1401 Harrison Ave., Kearny, NJ 07032-4310 (Hudson Co.)
Field Crew:	**Date:** **Project #:** 173044.FI.FI.07

Well Depth (ft.): Purge Methodology:
DTW (ft.):
Water Column (ft.):
Well Diameter (in.):
Gal. per ft.: Water Quality Meter:
Well Volume (gal.):
Depth of Screen (ft.):

Diameter	Gal. Per Foot	Diameter	Gal. Per Foot
2"	.163	5"	1.020
3"	.367	6"	1.469
4"	.653	8"	2.611

Field Parameters

	Time	DTW (tic)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/l)	Turbidity (NTU)	Color/Odor
	Stabilization	< 0.3'	300 - 500		+/- 0.1		+/- 3 %	+/- 10 mV	+/- 10%	+/- 10%	
Initial											
1 VOL											
2 VOL											
3 VOL											
4 VOL											
5 VOL											
6 VOL											
7 VOL											
8 VOL											
9 VOL											
10 VOL											
Post-Purge											

Remarks: Pump Intake Depth: Control Box Setting (Hz): Development: Sampling:

SAMPLING

Depth to Water Before Sampling:
Sample Methodology: Grunfos 2" RediFlow 2 Submersible Pump with 1/2 inch I.D. Teflon Lined Polyethylene Tubing - Low Flow Rate
Sample Name: QC Sample:
Sample Date/Time:
Sampler / Signature:
Filtered Metals Collected: Y / N Filter Size:
Sample Observations:
Parameters:

STANDARD OPERATING PROCEDURE
SUBSURFACE SOIL SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the protocol for sampling subsurface soils during the boring installation program. Soil samples will provide information on the nature and extent of site contamination.

2.0 Materials

1. Drill rig and associated boring equipment
2. Shovel
3. A stainless steel trowel
4. Stainless-steel tray or bowls
5. Photoionization (PID) detector
6. Sample Collection Log Sheet
7. Sample bottles
8. Shipping containers (coolers)

3.0 Procedure

3.1 The depth intervals from which subsurface soil samples for laboratory analyses will be collected will be determined using the decision-making process below after the soil core sleeves from the RotaSonic drilling method (10-feet long, 4-inch diameter) are brought to the surface.

The exact collection interval for each subsurface soil sample will be based on field screening observations of the soil core. The depth intervals sampled at each boring location will vary depending on the depths of the peat layer and native soil. The soil interval with the greatest indication (e.g., PID readings, visual staining) of potential contamination will be sampled for laboratory analysis. In the absence of field screening indications of contamination, soil samples will be collected from the pre-determined intervals described in this section.

Three soil samples will be collected from each of the shallow investigation locations. The samples will be collected from: the 0" – 6" bgs interval (shallow sub-surface soil), from the approximate middle of the boring (fill material), and from the bottom of the boring (fill material immediately above the peat layer).

Six soil samples will be collected from each of the deep investigation locations. These samples will be collected from the 0" – 6" bgs interval (shallow sub-surface soil), from the approximate middle of the fill material above the peat layer, from the bottom of the fill material immediately above the peat layer, from 12" – 18" into the peat layer, from the bottom of the peat layer, and from 12" – 18" below the peat layer within the native soil.

The core sleeves will be cut open and scanned with a PID in order to screen for VOC contaminants. .

3.2 Within each sampling interval, **the soil sample for VOC analysis will be collected first** (see SOP 17: Collection and Preservation of Soil Samples for VOC Analysis). Within each interval selected for sampling, the section from which the sample will be collected, will be selected based on the following criteria, listed in order of importance:

- results of PID measurements (soils with high PID readings will be sampled)
- visible staining or discoloration
- middle section of the core or professional judgment if the PID or observations do not indicate the presence of any VOCs

3.4 Collect the sample for the performance of the Shake Test second. See SOP No.: 18 for the procedures to follow in collecting this sample.

3.5 Once the sample for VOC analysis is collected, place the remaining soil from the interval to be sampled on a decontaminated stainless-steel tray. Remove rocks and organic matter from the soil and homogenize the soil volume using the coning and quartering method (ASTM C702-80) as described below.

In the coning and quartering method, the soil will be thoroughly mixed by turning the entire sample over three times using a stainless-steel trowel or spoon. Following the last turning, the entire sample will be shoveled into a conical pile in the middle of the tray. The conical pile will then be flattened to a uniform thickness and diameter by pressing down the apex. The flattened soil will be divided into four equal quarters. The sampling personnel will then make a determination as to whether the amount of soil on the tray is larger than the volume of the sample bottles. If the amount of soil is larger, one or two quarters will be discarded. If two quarters are discarded, opposite quarters will be selected. After removal of one or more quarters, the entire coning and quartering sequence will be repeated until the amount of soil on the tray is approximately equal to the volume of the sample bottles to be filled.

3.5 Place the required soil volumes in the sample bottles for the remaining laboratory analyses, tightly cap, and fill in all required information on the bottle label.

3.6 Immediately following sample collection, place the sample bottles in a cooler with ice. Maintain the samples at $4^0 \pm 2^0$ C.

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

ASTM Method C702-80. Reducing Field Samples of Aggregate to Testing Size

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE COLLECTION AND PRESERVATION OF SOIL SAMPLES FOR VOC ANALYSIS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the collection of soil samples for VOC analysis. This SOP will ensure that soil samples collected for VOC analysis are handled in a manner which will minimize the loss of contaminants due to volatilization and biodegradation. This SOP follows the steps in the "Draft Procedures for Collecting Samples When Using EnCore™ Samplers for Analysis Through the USEPA Contract Laboratory Program (CLP)".

2.0 Materials

a. En Core™ Samplers (5g)
b. 60ml wide mouth soil sample containers for dry weight
c. T-handle
d. Stainless steel spoon or spatula
e. Paper towel

3.0 Procedure

The RotaSonic core sleeves will be visually observed as they are brought to the surface and scanned with a PID in order to determine if they might contain VOC contaminants and to select the section of the pre-determined sample interval from which the sample for VOC laboratory analysis is to be collected.

The section of the pre-determined sampling interval from which the subsurface soil sample for VOC analysis will be collected, will be selected based on the following criteria, listed in order of importance:

1) results of PID measurements (soils with high PID readings will be sampled)
2) visible staining or discoloration
3) middle section of the core or professional judgment if the PID does not indicate the presence of any VOCs

For each soil sample, an interval of 2 feet of core material will be used (i.e., samples will not be composites of larger core intervals). Immediately after the depth interval to be sampled for VOCs is selected, the sample aliquot for VOC analysis will be collected using En Core Samplers. Note that duplicate samples for VOC analysis are to be collected from the same interval as close as possible to each other. These duplicate samples are also known as co-located samples. Once the sample for VOC analysis is collected, the remaining soil from the pre-determined sample interval will be placed in a stainless steel mixing bowl and the samples for the remaining analyses collected following the SOP.

3.1 Collect three En Core™ samples and one percent moisture sample (60ml wide mouth glass container with 5 - 10g of soil) for each sample point location.

3.2 Remove the sampler and cap from the En Core™ package and attach the T-handle to the sampler body.

3.3 Quickly push the sampler into a freshly exposed surface of soil (ground surface or soil core sampler) until the sampler is full.

3.4 Check to see whether the sampler is full by looking into the viewing hole in the T-handle. The back o-ring on the plunger will show in the viewing window when soil has fully pushed the plunger back. The plunger can only be rotated when it is completely pushed to the back of the sampler body. If the plunger can be twisted, this indicates that soil has completely filled the sampler and the back o-rings have sealed.

3.5 Scrape any excess soil flush with the edge of the sampler using a dedicated or decontaminated stainless steel trowel.

3.6 Use a paper towel to quickly and carefully wipe the sampler head so that the cap can be tightly attached and sealed.

3.7 To attach the cap, push the cap on with a twisting motion. The cap is properly sealed when the two locking arms are completely seated over the ridge on the body of the sampler.

3.8 Complete the sample label on the En Core™ zipper lock package.

3.9 Fill in the sample identification number (i.e. CLP number,) on the self adhesive label attached beneath the sample label on the En Core™ package.

3.10 Tear the self adhesive label at the perforation and attach the label to the rim of the sampler cap.

3.11 Place the sampler back into the En Core™ zipper lock package and seal the zipper lock. The CLP Sample label may be used as a custody seal to be placed over the opening of the En Core™ zipper lock package to ensure sample integrity. If the CLP label is not used as a custody seal, the CLP sample label must be attached to the exterior of the En Core™ package and a custody seal place over the opening of the package.

3.12 Repeat the procedure above for the other two samplers.

3.13 Once all three samplers have been filled, labeled and packaged, place the three En Core™ packages into one large zipper lock bag with one completed sample tag. Sample tags are required by the CLP, unless waived by the Regional Sample Control Coordinator (RSCC).

3.14 Collect the percent moisture sample in a separate sample container (60ml wide mouth glass container).

Use a paper towel to clean the threads of the sample container and cap. Ensure that the sample bottle is tightly sealed to prevent loss of soil moisture.

3.15 Double volume is required for the collection of the MS/MSD samples. This includes six En Core™ samplers and two 60ml wide mouth glass container.

3.16 Store all samples in a cooler with bagged ice to maintain 4 degrees Celsius while storing on site and during shipment to the laboratory.

3.17 Samples must be shipped off site to the laboratory within 24 hours.

3.18 Samples must be received by the laboratory for preservation and preparation for extraction with in 2 days from the date of sample collection.

4.0 Maintenance

Not Applicable.

5.0 Precautions

The En Core™ sampler can not be used in the normal manner when sampling non- cohesive/unconsolidated soils (e.g., sands). When sampling sandy soils, the procedure to be used in place of step 3 above is as follows:

Manually pull back the plunger to form the seal on the back of the sampler body. Use a dedicated or decontaminated stainless steel trowel or spatula as a rigid structure to push the soil into the sampler. The soil should be packed tight to completely fill the sampler. Proceed through the remaining steps.

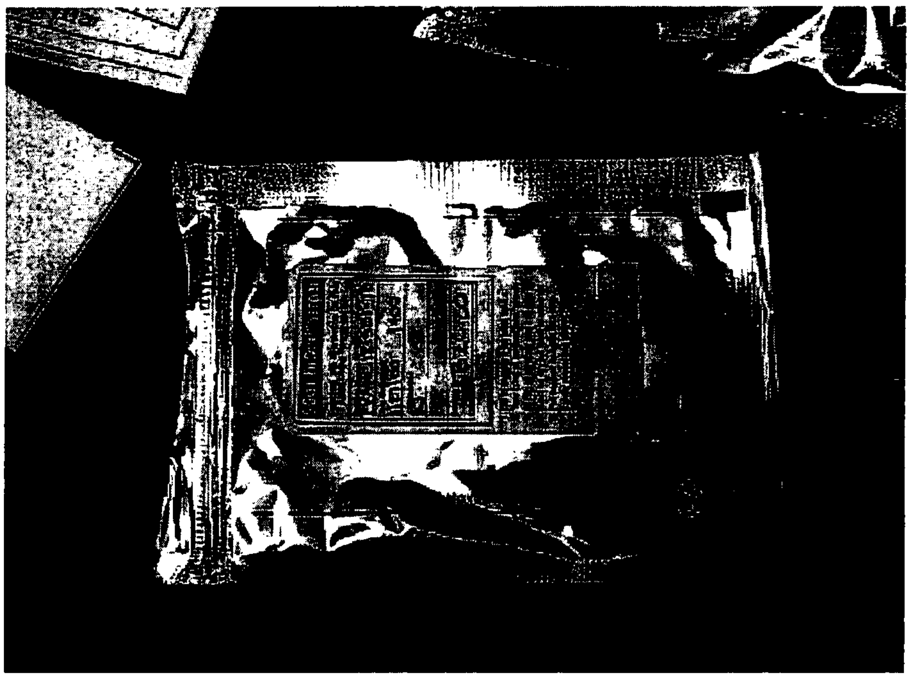
6.0 References

This SOP follows the steps in the "Draft Procedures for Collecting Samples When Using EnCore™ Samplers for Analysis Through the USEPA Contract Laboratory Program (CLP)".

7.0 Attachments

Figure1.

Figure 1 - En Core™ Sampler and Zipper Lock Package



Sample Designation, Date / Time, Sampler's Initials, and CLP Number on Baggie with Custody Seal

CLP Number ONLY on EnCore Sampler

STANDARD OPERATING PROCEDURE
LNAPL SHAKE TEST

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the collection of shake test observations and quantitative measurements of LNAPL trapped in soil pores, and to describe qualitative Sudan IV hydrophobic dye test for the indication of LNAPL in residual water from shake test samples. This SOP will provide a standardized procedure for execution of the subjective/qualitative aspects of the tests, and will help ensure that uniform observations are obtained for the quantitative measurements.

2.0 Materials

1. Clear Glass Jar, Wide Mouth, with Lid (2 oz) – for sample collection
2. Clear Glass Jar, Wide Mouth, with Lid (8 oz) – for sample testing
3. 10 oz. Deionized or Potable Water
4. 2 oz. of soil to be sampled
5. Sudan IV – Hydrophobic dye for indication of LNAPL
6. Scoopula for dispensing Sudan IV
7. Paper Towel
8. Shake Test Observation Form
9. Shake Test Sample Tracking Log
10. Ruler (millimeter scale)
11. PPE: Nitrile Gloves and Eye Protection

3.0 Procedures

<u>3.1 Shake Test with simultaneous Sudan IV Dye Test</u>

The **shake test** is designed to provide a qualitative determination as to whether LNAPL is trapped between the soil pores of a collected sample, and a quantitative measurement of any LNAPL that is observed. The **Sudan IV** test is designed as a supplemental test to the shake test. The Sudan IV test will provide an additional qualitative evaluation of the presence of NAPLs for differentiation between turbid water and oily LNAPL in residual water from the shake test. Observation and measurement of the LNAPL is a subjective exercise, so steps will be taken to ensure that the same field team member performs all of the tests in order to manage testing and observation errors.

Generally described, an aliquot of soil is placed in a clear glass jar, water is added, a dose of Sudan IV dye is added, and the mixture is shaken vigorously. The resulting solution is allowed time to settle and equilibrate, and qualitative observations are made. The shake test will determine if a phase separation has occurred between the water and any LNAPL that may have been present within the matrix of the soil, and the Sudan IV test will determine if the hydrophobic dye has reacted with NAPLs and dispersed in a vibrant red color, or has remained concentrated in the water as globules of rust-colored powder. A quantitative measurement of the thickness of the resulting free-phase LNAPL layer floating on the water surface is then collected. The shake test and Sudan IV data will then be evaluated in relation to the PID readings and visual observations from the lithologic logging of the soil core, LNAPL thickness measurements collected from the piezometer, and the results of the laboratory analyses of the soil samples collected at that location.

Shake test and Sudan IV sampling will be performed simultaneously from the soil borings that will be installed radially around well MW-3 as part of the LNAPL delineation program. Shake test and Sudan IV samples will be obtained from the same intervals from which soil samples are collected for laboratory analysis. If field observations indicate the presence of LNAPL at other depths, additional samples will be collected for the performance of the LNAPL field screening tests at the discretion of the FTL.

In addition, if there is evidence of LNAPL in the soil pores at any of the other soil boring locations installed during this RI, or staining of the soil suggests the potential presence of LNAPL in the soil pores, samples for performance of the shake test and Sudan IV test will be collected at these locations. The decision to collect these additional samples will be made by the FTL.

3.1.1 Shake Test and Sudan IV Test Procedures

1. Appropriate PPE is required, including Nitrile Gloves and Eye Protection. ***(Sudan IV is an irritant and possible mutagen – avoid skin or eye contact and inhalation of the powdered dye. Refer to the Health and Safety Plan before using the dye.)***

2. Determine the depths at which the soil samples for laboratory analyses will be collected.

3. Determine if samples for the performance of the Shake Test and Sudan IV Test should be collected at additional depths based on the following: visual observations of LNAPL, staining, PID readings, professional judgement.

4. Collect a sample of soil from each required depth directly from the soil core into a 2 once clear glass, widemouth jar. Ensure that the jar is filled completely to the top. Use a scoop to pack the soil into the jar.

5. Label the jar and transport to the field trailer for performance of the shake test.

The following information will be recorded on the label:

Station: ____________________	**Sample Depth:** ______________
Date: ______________________	**Time:** ____________________

6. The Sample Manager will log the receipt of the sample into the Shake Test sample log and perform the test.

7. Transfer the entire 2 ounce aliquot of soil directly into an 8 ounce, clear glass, widemouth jar. Remove any large pebbles or organic pieces from the sample.

8. Add approximately 10 ounces of water to the soil in the sample jar. An adequate volume of water must be added to completely saturate the soil and fill the jar with at least 1 inch of free water above the soil. Either deionized water or potable water may be used.

9. Add a small amount (approximately 10 milligrams – an amount about the size of a pea) of Sudan IV dye in powder form to the container. Use extra care to ensure that no parts of the body are exposed to the dye.

10. Close the jar lid and vigorously shake the jar to agitate the soil, Sudan IV, and water slurry. The objective of this process is to extract entrained LNAPL from the soil matrix and mix the Sudan IV dye with the water/LNAPL solution.

11. Allow the resulting solution to stand, undisturbed, for approximately 30 minutes. This will provide time for turbidity in the solution to settle, and phase-separation between LNAPL and water. The reaction time between NAPLs and Sudan IV is nearly instantaneous.

12. While minimizing disturbance to the sample container, observe the aqueous solution for the presence of a separate-phase LNAPL floating on top of the water (or a DNAPL at the bottom of the water column). Also observe the solution for a vibrant red staining discoloration created by the reaction between NAPL and Sudan IV dye. If no reaction has occurred, the powdered dye will remain as dark, rusty colored globules that have not reacted with the water. A limited amount of leaching will occur. Record the qualitative observations on the "Shake Test & Sudan IV Observations" field parameter form.

13. If a distinct LNAPL layer is observed, measure the thickness of the layer in millimeters. Record the data on the "Shake Test & Sudan IV Observations" field parameter form.

An LNAPL layer thickness of less than 1 millimeter will be documented as a "Thin Sheen".

14. Catalog and archive the test sample. The archive of test samples will be maintained until the EPA determines that the samples can be disposed.

15. Ultimate disposal of the test samples will be in the same manner as the soil and aqueous IDW from the Phase I RI.

NOTE: Groundwater samples can be screened for NAPLs in the same manner as soil samples. Do NOT purge the monitoring well prior to sample collection. Collect groundwater samples using a bottom-filling bailer. Collect the groundwater sample from the top of the water column for LNAPL determination, and from the bottom of the well for DNAPL determination. Perform the Shake Test and Sudan IV Test on the groundwater sample as described above.

4.0 Maintenance
Not Applicable.

5.0 Precautions
Not Applicable

6.0 References
Not Applicable.

6.0 Attachments
Shake Test & Sudan IV Observations
Shake Test & Sudan IV Sample Tracking Log
Shake Test Sample Results

CH2MHILL

Boring: ______________

Sample: ______________

Depth: ______________

Sample Time: ______________

Shake Test and Sudan IV Test Observation Form

(For Determination of LNAPL Presence)

Project: Diamond Head Oil, 1401 Harrison Ave, Kearny, NJ 07032-4310 (Hudson Co.)

Date: **Lab CASE #** **Project #:** 173044.FI.FI.07

Soil Description: ____

____

Shake Test Fluid Observations:

Time: **Ended Agitation:** ______________ **Made Observations:** ______________

Fluid Clarity (Turbidity): Clear / Translucent (Slightly Turbid) / Opaque (Very Turbid)

Fluid Color: ____

LNAPL Observed: YES / NO / INCONCLUSIVE

Phase Separation: Distinct / Irregular / Intermixed **LNAPL Thickness (mm):** ______________
(< 1mm = Thin Sheen)

LNAPL Color: ____

LNAPL Viscosity: (1=Water, 5=Honey) 1 2 3 4 5

Sudan IV Test Observations

LNAPL Observed: YES / NO / INCONCLUSIVE

Comments: ____

____

SOP 18 - Exhibit 2
Shake Test and Sudan IV Test Sample Tracking Log
Diamond Head Oil Site RI/FS

Station ID	Depth of Sample Top	Depth of Sample Bottom	[illegible] Sample Date	Sample Time	Time Received at Trailer	Time Analysis Completed	Measured LNAPL Thickness mm	LNAPL Remaining in Soil Pores	Comments
Example									
PZ-01	0	2	11/26/2001	14:10	16:00	17:00	5		
PZ-01	10	12	11/26/2001	14:26	16:00	17:00	4		
PZ-01	20	22	11/26/2001	15:40	16:00	17:00	0	Y	

STANDARD OPERATING PROCEDURE
MONITORING FOR TIDAL INFLUENCES

1.0 Scope and Application

This Standard Operating Procedure (SOP) provides a description of and technical guidance for determining any influence of tides on ground water levels at the Diamond Head Oil Superfund Site.

Pressure transducers will be installed in each well (both shallow and deep) of the four well couplets installed on-site (eight total wells). Water levels will be continuously recorded over a one-week period. If the schedule permits, transducers will be installed during the week of a full moon, when tidal influences are greatest.

After the one-week monitoring period, the data will be evaluated to determine any tidal influence on ground water elevation.

2.0 Materials

a. Electronic water level indicator
b. In-Situ brand miniTROLL transducer with proper PSI rating- (8- total)
c. Laptop Computer with Win-Situ 2000 software (or newest version) and cable
d. Well construction logs
e. Photoionization Detector (PID)

3.0 Procedures

3.1 <u>Test Preparation</u>

3.1.1 Remove the well cap and check for organic vapors using a PID.

3.1.2 Determine the static water level and well depth with the electronic water level indicator and record the information in the field logbook.

3.1.3 Using the well logs, determine if the static water level is above or within the screened interval of the well.

3.1.4 Record the transducer serial number and PSI rating value in the field logbook. These data are stamped on the side of each probe. Lower the transducer using the attached cable approximately 5-10 feet below the water level. Fasten the transducer cable securely to the well by using zip ties. The excess data cable can be coiled and left inside a Ziploc bag for an extended period if necessary. Connect the transducer cable to the laptop computer.

MiniTROLL transducer ratings should be selected relative to the length of water column (head) above the suspended transducer.

Water Column	Pressure Rating
0 – 35 ft	15 psi
0 – 69 ft	30 psi
0 – 231 ft	100 psi
0 – 692 ft	300 psi

3.1.5 Activate the Win-Situ 2000 software on the computer, access the transducer settings and enter the test parameters as required. Follow the instruction manual accompanying the instruments/software for specific programming procedures. In-Situ's 24-hour service phone number is 1-800-742-8213.

Pertinent Settings Include:
Data collected under a linear schedule
Maximum time between data points: 2.0 minutes
Specific Gravity: 1.00 (water)
Reference Datum Mode: Top Of Casing
User Defined Reference: 0.00 ft H_2O
Datum Referenced at: Start of Test
Units: Feet of Water

3.1.6 Check the performance of the transducer by manually collecting an instantaneous pressure head reading and then raise the transducer 5 feet and repeat the process. Reset the transducer at the target depth and wait 5 minutes and check the head level again to determine if the water level has stabilized. If the head value has changed, check periodically until the water level remains constant for at least 5 minutes.

3.2 Test Performance

Upon installing the pressure transducer in each well, the data logger is started. Ensure that the data logger or cable is not tampered with throughout the duration of the test. After a one-week period, the data will be downloaded from each transducer according to the procedures set forth in the Win-Situ 2000 software manual. Check the Win-Situ file on the laptop computer to ensure proper files were downloaded and saved on the computers hard drive. The data shall be saved in the project file on the network server immediately upon returning to the office.

3.3 Decontamination Procedures

3.3.1 Following the completion of all eight tests, the transducers and probe will be removed from the well and cleaned in accordance with the requirements described in the SOP on Equipment Decontamination.

3.4 Data Analysis

3.4.1 Scan through the test data in the field. (Note: If the schedule permits, data will be downloaded once during the middle of the test period, while the tests are still running.)

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 The proper parameter settings must be used when defining a test.

5.2 Field personnel should always scan through the data to determine that the test was completed properly.

5.3 The transducer and transducer cable should not be disturbed during the tests, because it may result in a change to the reference level.

5.4 Precautionary measures must be taken not to lose a transducer in a well.

5.5 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

InSitu, Inc. *miniTroll system* – Operator's Manual. Version 1.0, January 2000.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE
SURFACE WATER SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for sampling surface water. This procedure can be applied to the collection of surface water samples from streams and other surface water bodies.

If multiple surface water samples are to be collected from a surface water body, samples will first be collected from the furthest point downstream, moving upstream as the sampling progresses. Surface water will be sampled before sediment to prevent the collection of fine-grained substrate, which may be introduced into the surface water from sediment sampling activities.

This SOP is based on the technical requirements described in the NJDEP guidance document "Field Sampling Procedures Manual (May 1992)" and the New Jersey "Technical Requirements for Site Remediation (N.J.A.C. 7:26E, May 1997)". Use of this SOP will provide surface water samples for analytical data for the implementation of site characterizations, risk assessments, and the evaluation of remedial alternatives.

2.0 Materials

a. Sample containers
   Unpreserved pre-cleaned and certified wide mouth glass jars for sample collection (8-oz and 32-oz)
   And
   Pre-preserved sample containers into which samples will be transferred from the wide mouth jars and sent to analytical laboratory
b. Multi-probe water quality meter
c. Hip or chest waders
d. Horiba U-10 Water Quality Meter (or equivelant)

3.0 Procedure

Sample containers will be rinsed with the sample water prior to collection.

3.1 Remove the cap from an unpreserved sample bottle. Use an 8-oz wide mouth glass jar to collect the sample for VOC analysis and use a 32-oz wide mouth glass jar to collect the sample for SVOC and metals analysis. Use a new sampling bottle at each sampling location.

3.2 Hold the bottle upside down, immerse the top of the bottle several inches under the water, then turn the bottle upright to fill. This will prevent floating debris or surface film from entering the sample.

3.3 Remove the bottle from the water, transfer the appropriate sample volumes to the pre-preserved sample bottles, and cap. Sample for VOC analysis will be transferred first by taking great care to minimize aeration of the sample. Two dips will be needed to fill the bottles for SVOC analysis.

3.4 Surface water samples should be immediately stored at 4°C.

3.5 The following parameters will be measured before and after sample collection using a multi-probe water quality meter: temperature, pH, turbidity, DO, ORP, and specific conductivety. The multi-probe water quality meter will be calibrated before each day of sampling and the probe will be decontaminated between sampling locations.

3.6 For all surface water samples,

- Photograph the location
- Describe each location in relation to nearby surface features and if feasible record distances to be able to locate again should the stake be removed
- Place a numbered stake above the visible high water mark on the bank closest to the sampling location.
- Ensure that the photographs and descriptions are adequate to allow the sampling location to be relocated at some future date
- Record the following:

    Depth of water at the location,
    The distance and direction of the location from the shoreline,
    Qualitative observation of flow conditions and direction.

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 All personnel wearing waders and entering the stream should be certain of their footing so not to slip while in the water. Refer to the Health and Safety Plan for other appropriate health and safety precautions.

5.2 Decontaminate the sampling equipment between sampling locations.

5.3 Avoid disturbing the surface water during submersion of the sample bottles.

6.0 References

NJDEP, 1992. NJDEP Field Sampling Procedures Manual.

7.0 Attachments

None

STANDARD OPERATING PROCEDURE
SEDIMENT SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for sampling sediments. This procedure can be applied to the collection of sediment samples from streams, rivers, lakes, ponds, and other surface water bodies.

If multiple sediment samples are to be collected from a surface water body, samples will first be collected from the furthest point downstream, moving upstream as the sampling progresses. Where applicable, surface water will be sampled before sediment to prevent the collection of fine-grained substrate, which may be introduced into the surface water from sediment sampling activities.

This SOP is based on the technical requirements described in the NJDEP guidance document "Field Sampling Procedures Manual (May 1992)" and the New Jersey "Technical Requirements for Site Remediation (N.J.A.C. 7:26E, May 1997)". Use of this SOP will provide sediment samples for analytical data for the implementation of site characterizations, risk assessments, and evaluation of remedial alternatives.

2.0 Materials

a. Stainless-steel bowl
b. Stainless-steel petite ponar dredge
c. Stainless-steel trowel
d. Stainless-steel bucket auger
e. Sample containers
f. Photoionization detector (PID)
g. Hip or chest waders

3.0 Procedure

3.1 Samples can be collected with decontaminated stainless-steel bucket auger if there is little or no water on top of the sediment at the particular sampling location, and if the water velocity is low. For sampling locations where the water above the sediment is greater than 4 inches in depth, or the water velocity is high, a decontaminated stainless-steel petite ponar dredge or other device that eliminates sample washing will be used. This will ensure the integrity of the surface layer of sediment and will minimize the loss of fine-grained material in the sediment. All efforts will be made to collect sediment samples from the slower-flowing, depositional portions of the creeks. The fine-grained organic sediments will be targeted for collection.

3.2 The collected sediments sample will be placed in a stainless steel pan; care will be taken not to spread the sediment sample in order to minimize the potential for VOC losses through volatilization. The sample for VOC analysis will be collected first following the procedure in the SOP for collecting soil samples for VOC analysis.

3.3 Following the collection of the sample for VOCs analysis, the sediment pile will be screened with a PID and the results recorded. Rocks, twigs, leaves and other debris will be removed and the sediments will be thoroughly mixed by turning the entire sample over three times using a stainless-steel trowel. Following the last turning, the required sediment volumes for the remaining analyses will be placed in the sample bottles. Sampling personnel will avoid decanting off the excess liquid while homogenizing the sample.

3.4 A description of properties of the sediment (color, texture, odor, organic content, grain size) will be recorded in the field logbook immediately after sample collection.

3.5 Sediment samples will be immediately stored at 4°C.

3.6 For all sediment samples:

- Photograph the location
- Describe each location in relation to nearby surface features and if feasible record distances to be able to locate again should the stake be removed
- Place a numbered stake above the visible high water mark on the bank closest to the sampling location.
- Ensure that the photographs and descriptions are adequate to allow the sampling location to be relocated at some future date
- Record the following:

  Color
  Texture
  Odor
  Organic content
  Grain size
  PID readings
  Other qualitative observations

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 All personnel wearing waders and entering the stream should be certain of their footing so not to slip while in the water. Refer to the Health and Safety Plan for other appropriate health and safety precautions.

5.2 Decontaminate the sampling equipment between sampling locations.

6.0 References

NJDEP, 1992. NJDEP Field Sampling Procedures Manual.

USEPA, 1989. Region II CERCLA QA Manual. Revision 1.

7.0 Attachments

None

STANDARD OPERATING PROCEDURE
NATURAL GAMMA BOREHOLE LOGGING

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for conducting downhole borehole geophysical logging using natural gamma radiation. The drilling contractor will provide, operate, and decontaminate the equipment for completing this logging.

Nearly all natural gamma rays in the earth come from potassium isotope 40 and decay products of uranium and thorium. Natural gamma rays are usually highest in shales and clays. However, a small amount of clay or in a sand can sometimes yield a high response. A quantitative estimate of the amount of clay or sand in a layer cannot be obtained from a natural gamma ray log by itself. The interpretation of natural gamma ray logs is strictly qualitative. A natural gamma ray detector contains a sodium iodide crystal which gives a flash of light when struck by a gamma ray. The results of a gamma ray log are in counts per second. Gamma ray tools can be used in uncased, steel-cased, and PVC-cased holes, but are ineffective following construction of typical monitor wells due to the interference of bentonite and/or portland cement grout and misrepresentative well gravel sands.

2.0 Materials

a. A geophysical logging system, including probe, cables, tripod and winch
b. Digital data recorder

3.0 Procedure

3.1 Each borehole will be logged through the steel RotaSonic drill stem upon drilling to the terminal depth and before removal of the drill stem or construction of a monitoring well.

3.2 Lower decontaminated probe and cable of the geophysical logging system to the bottom of the hole.

3.3 Raise the probe at a constant velocity, using a winch and record data on an electronic data logger.

3.4 Immediately upon completion of logging, the drilling contractor will generate a graph of the log. The CH2M HILL FTL will review the log. If log looks unusual or data were not recorded completely or properly, the FTL will instruct the drilling contractor to repeat the logging.

3.5 The probe, cable and all other equipment coming in contact with groundwater or the inside of the well casing will be decontaminated immediately after use following the SOP on Equipment Decontamination.

3.6 CH2M HILL will record all information concerning the logging activity in a bound field notebook. The date, time, and well number will be recorded on the paper printout of data from the data recorder.

3.7 The final deliverable from the digital gamma logging efforts will include a total of six paper copies of each boring log and an electronic copy for future evaluation and manipulation of the data through the project's electronic database/GIS system.

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 Refer to the Health and Safety Plan for appropriate health and safety precautions.

6.0 References

None.

7.0 Attachments

None.

ATTACHMENT C

Health and Safety Plan

CH2M HILL HEALTH AND SAFETY PLAN

This Health and Safety Plan (HSP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign Attachment 1.

Project Information and Description

PROJECT NO: 173044

CLIENT: United States Environmental Protection Agency, Region II.

PROJECT/SITE NAME: Diamond Head Oil Refinery

SITE ADDRESS: 1401 Harrison Turnpike, Kearney New Jersey 07029

CH2M HILL PROJECT MANAGER: Juliana Hess/NJO

CH2M HILL OFFICE: 99 Cherry Hill Road
Suite# 640
Parsippany, NJ 07054

DATE HEALTH AND SAFETY PLAN PREPARED: 05/17/2002

DATE(S) OF SITE WORK: 05/17/2002 through 05/16/2003

SITE ACCESS: None

SITE SIZE: 15 acres

SITE TOPOGRAPHY: Flat

PREVAILING WEATHER: The moderate continental climate varies between average highs around 85° F in July to average lows near 23° F in January. The average amount of precipitation is 3.5 inches per month.

SITE DESCRIPTION AND HISTORY: The site is a former oil refinery operation where dumping has occurred. Approximately 1/2 of the site (7 acres) is occupied by a landfill of construction and other miscellaneous debris. A geophysical survey has revealed no areas of buried drums. The other half of the site was occupied by tanks, a 5-acre oil lagoon and two buildings. The oil lagoon has been excavated and filled in and only the foundations of the building are currently present. Historic information suggests the presence of large LNAPL which CH2M Hill will attempt to delineate.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED: The work involves a remedial investigation with the following field tasks: Soil boring and well installation, sampling of all media, hydrogeologic testing, management of generated wastes, and establishing field facilities (trailer, etc).

Site Map

This page is reserved for a Site Map.

Note locations of Support, Decontamination, and Exclusion Zones; site telephone; first aid station; evacuation routes; and assembly areas.

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

- Surveying
- Test pit excavation
- Drilling & Monitoring Well installation
- Groundwater monitoring
- Soil Sampling
- Surface water sampling shore
- Sediment sampling from shore
- Oversight of generated wastes loading for disposal.

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

TASKS	CONTROLS
• Utility location • Electrical installation • Grubbing and Clearing • Mechanical installations (equipment, pumps, etc.) • Waste removal/hauling	• Brief on hazards, limits of access, and emergency procedures • Post contaminant areas as appropriate (refer to Section 8.2 for details) • Sample and monitor as appropriate (refer to Section 5.0)

1.2 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIAL HAZARDS	TASKS						
	Test pit/ Excavation	Drilling, & Well installation	Groundwater monitoring, aquifer testing	Surface water and sediment sampling from the shore	Surveying	IDW drum sampling and disposal	Observation of loading material for offsite disposal
Flying debris/objects	X	X		X		X	X
Noise > 85dBA	X	X					X
Electrical	X	X	X				
Suspended loads	X	X					X
Buried utilities, drums, tanks	X	X					
Slip, trip, fall	X	X	X	X	X	X	X
Back injury	X	X	X	X		X	
Confined space entry	X				X		
Trenches / excavations	X						
Visible lightning	X	X	X	X	X	X	X
Vehicle traffic							X
Elevated work areas/falls	X			X			
Fires	X	X		X		X	
Entanglement		X					
Drilling		X					
Heavy equipment	X	X					X
Working near water				X			
Working from boat							
IDW Drum Sampling						X	

2 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 6. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Initially and as conditions change.**

2.1 Project-Specific Hazards

2.1.1 Drilling (Reference CH2M HILL SOP HS-35, *Drilling*)

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.

2.1.2 Excavation (Reference CH2M HILL SOP HS-32, *Excavations*)

- Do not enter the excavations unless completely necessary, and only after the competent person has completed the daily inspection and has authorized entry.
- Follow all excavation entry requirements established by the competent person.
- Do not enter excavations where protective systems are damaged or unstable.
- Do not enter excavations where objects or structures above the work location may become unstable and fall into the excavation.
- Do not enter excavations with the potential for a hazardous atmosphere until the air has been tested and found to be at safe levels.
- Do not enter excavations with accumulated water unless precautions have been taken to prevent excavation cave-in.
- H&S Self-Assessment Checklist – Excavations, found in Attachment 5 of this plan, should be used to evaluate excavations prior to entry.

2.1.3 Earthmoving Equipment (Reference CH2M HILL SOP HS-27, *Earthmoving Equipment*)

- Only authorized personnel are permitted to operate earthmoving equipment.
- Maintain safe distance from operating equipment and stay alert of equipment movement. Avoid positioning between fixed objects and operating equipment and equipment pinch points, remain outside of the equipment swing and turning radius. Pay attention to backup alarms, but not rely on them for protection. Never turn your back on operating equipment.
- Approach operating equipment only after receiving the operator's attention. The operator shall acknowledge your presence and stop movement of the equipment. Caution shall be used when standing next to idle equipment; when equipment is placed in gear it can lurch forward or backward. Never approach operating equipment from the side or rear where the operator's vision is compromised.
- When required to work in proximity to operating equipment, wear high-visibility vests to increase visibility to equipment operators. For work performed after daylight hours, vests shall be made of reflective material or include a reflective stripe or panel.
- Do not ride on earthmoving equipment unless it is specifically designed to accommodate passengers. Only ride in seats that are provided for transportation and that are equipped with seat belts.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Earthmoving equipment shall not be used to lift or lower personnel.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.

2.1.4 Working Above or Near Water

- Fall protection should be provided to prevent personnel from falling into water. Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PFDs or life jacket, shall be worn.
- Inspect PFDs prior to use. Do not use defective PFDs.
- A life-saving skiff must be provided for emergency rescue.
- A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope must be provided for emergency rescue.

2.1.5 Cranes, Hoists, and Rigging

- Only certified crane operators are permitted to operate cranes.
- Maintain safe distance from operating cranes and stay alert of crane movement. Avoid positioning between fixed objects and operating cranes and crane pinch points, remain outside of the crane swing and turning radius. Never turn your back on operating cranes.
- Approach cranes only after receiving the operator's attention. The operator shall acknowledge your presence and stop movement of the crane. Never approach operating cranes from the side or rear where the operator's vision is compromised.
- When required to work in proximity to operating cranes, wear high-visibility vests to increase visibility to operators. For work performed after daylight hours, vests shall be made of reflective material or include a reflective stripe or panel.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Cranes shall not be used to lift or lower personnel.
- If crane becomes electrically energized, personnel shall be instructed not to touch any part of the crane or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the crane.
- Do not exceed hoist load limits.
- Ensure load is level and stable before hoisting
- Inspect all rigging equipment prior to use. Do not use defective rigging for any reason.
- Only use rigging equipment for the purpose it was designed and intended.

2.1.5 Welding and Cutting

- Only authorized and trained personnel are permitted to operate welding/cutting equipment.
- Do not enter areas where welding/cutting operations are taking place unless completely necessary and only after receiving permission from the welding/cutting operator.
- If you must be present in an area during welding/cutting operations, position yourself behind flash screens or wear glasses/goggles with lenses of appropriate darkness.
- Do not look directly at the welding/cutting flash or at reflective surfaces surrounding welding/cutting operations.
- Avoid contacting compressed gas cylinders. Cylinders should be firmly secured in an upright position at all times.
- Be aware of tripping hazards created by welding hoses, power cables, leads, and cords positioned on walking surfaces.

2.2 General Hazards

2.2.1 General Practices and Housekeeping (Reference CH2M HILL SOP HS-20, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HS-05, *Hazard Communication)*

The SSC is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods)*

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

2.2.4 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

2.2.5 Lifting (Reference CH2M HILL SOP HS-29, *Lifting*)

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift -- especially for heavy or awkward loads.
  - Make sure the path of travel is clear prior to the lift.

2.2.6 Fire Prevention (Reference CH2M HILL SOP HS-22, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.7 Electrical (Reference CH2M HILL SOP HS-23, *Electrical*)

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - equipped with third-wire grounding.
  - covered, elevated, or protected from damage when passing through work areas.
  - protected from pinching if routed through doorways.
  - not fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kV or less, and 10 feet plus ½ inch for every 1 kV over 50 kV.
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

2.2.8 Stairways and Ladders (Reference CH2M HILL SOP HS-25, *Stairways and Ladders*)

- Stairway or ladder is generally required when a break in elevation of 19 inches or greater exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials
- Straight and extension ladders must be tied off to prevent displacement
- Ladders that may be displaced by work activities or traffic must be secured or barricaded
- Portable ladders must extend at least 3 feet above landing surface
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder
- Stepladders are to be used in the fully opened and locked position
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder
- Fixed ladders $\geq$ 24 feet in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than six feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

2.2.9 Heat Stress (Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SSC/DSC to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.
The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

2.2.10 Cold Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SSC/DSC to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

2.2.11 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service

Name: **"One Call"**
Phone: **1-800-272-1000**

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change n advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

2.2.12 Confined Space Entry

(Reference CH2M HILL SOP HS-17, *Confined Space Entry*)

No confined space entry will be permitted. Confined space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and hazards.

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

2.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

*Note: Although we will clear vegetation along a 20 foot transects where we do the drilling, we still will need to go through brush to get to drilling locations. **See Attachment #8** for more Details about ticks.*

2.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.5 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.4 Radiological Hazards and Controls

Hazards	Controls
None Known	None Required

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	SS: 6.9 mg/kg HJJB-S10	1 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Chromium	SS: 3,800 ppm (99 data)	0.5 mg/ m^3	250 mg/ m^3	Irritation to the eyes, skin. Lung fibrosis.	NA
Cadmium	Solid: 58.7 mg/kg	0.005 mg/m^3	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA
Napthalene	SS: 660 mg/kg HJJB-S5	10 ppm	250 ppm	Irritation to the eyes, headache, confusion, excitement, nausa, vomit, abdominal pain, irritation of the bladder, profuse sweating, jaundice, hematuria, hemoglobinuria, renal shutdown, , dermatitis, optical neuritis, cornia damage.	8.12
Lead	SB: 76,200 mg/kg HJJB-S10	0.05 mg/m^3	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
PNAs (Limits as Coal Tar Pitch) - Benzo (g,h,I) perylene - Indeno(1,2,3-cd)pyrene - Benzo(a)pyrene - Benzo(k)fluoranthene - Acenaphthene - Fluorene - Phenanthrene - Anthracene - Pyrene - Benzo (a)anthracene - Chrysene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Benzo(a)pyrene - 4-Chloro-3Methylphenol	GW: 400 mg/l HJJB-S5	02 mg/m^3	80 Ca	Dermatitis and bronchitis	UK

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Tetrachlorethene	GW: 250 mg/l HJJB-LIQ-1	1 ppm	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
Xylenes	SS: 100 mg/kg HJJB-S10	100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of PEL, REL, or TLV listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training)*

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Andrew Judd	NJO	RI Lead and Field Team Lead	Level C SSC; FA-CPR
John Loeffel	NJO	Field Team Lead	Level C SSC
Christopher Hauptfleish	NJO	Team member	Level C SSC; FA-CPR
Amini Boston	NJO	Team member	Level C SSC; FA-CPR
Kelley Curran	NJO	Team member	Level C SSC; FA-CPR
Wojciech Winkler	PHL	Team member	Level C SSC; FA-CPR
Brian Wied	PHL	Team member	Level C SSC; FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name: Griselle Diaz-Cotto
Phone: 212 637 4430

3.2.2 CH2M HILL

Project Manager: **Juliana Hess/NJO**
Health and Safety Manager: **Steve Beck/MKE**
Field Team Leader: Andrew Judd or John Loeffel
Site Safety Coordinator: Andrew Judd or John Loeffel

The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

Subcontractor: To Be Determined (TBD) Subcontractor Contact Name: Telephone: Subcontractor Task: **Surveying**	Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Boring and well installation**
Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Site Clearance**	Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Excavating**
Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Electric and Phone Service**	Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Waste Disposal**
Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Utility clearance**	Subcontractor: TBD Subcontractor Contact Name: Telephone: Subcontractor Task: **Installation of gate in fence**

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 6 are to be used by the SSC to review subcontractor performance.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.

- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

PPE Specifications [a]

Tasks	Level	Body	Head	Respirator [b]
• General site entry • Surveying • Observation of material loading for offsite disposal	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Surface water sampling • Aquifer testing • Sediment sampling • Soil sampling	Modified D	Work clothes or cotton coveralls **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Groundwater sampling • Soil boring • Investigation-derived waste (drum) sampling and disposal • Test pit excavation	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.
• Tasks requiring upgrade per Air Monitoring specifications outlined in Section 5.1.	C	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].
• Not Authorized.	B	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA); MSA Ultralite, or equivalent.

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SSC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)—then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-06, *Air Monitoring)*

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]		Frequency [b]	Calibration
PID: MiniRae 2000 with 10.6eV lamp or equivalent	All intrusive tasks	0-1 ppm → 1-10 ppm → >10 ppm →	Level D Level C Level B	Initially and periodically during task	Daily
CGI: VRae or equivalent	Drilling Excavating	0-10% LEL: → 10-25% LEL:→ >25% LEL:→	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2 Meter: VRae or equivalent	Drilling Excavating	>25%[c] O_2: → 20.9%[c] O_2: → <19.5%[c] O_2: →	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily
Dust Monitor: MiniRam PDM-3, or equivalent	Drilling Excavating	< 1 mg/m³ → > 1 mg/m³ →	Continue Implement dust suppression; contact HSM to determine need for lead air monitoring	Initially and periodically during tasks	Not Applicable
Noise-Level Monitor [d]: Voice	Drilling Excavating Heavy Equipment Use	Must raise voice and shout to communicate at 3 feet→	Hearing protection required Stop; re-evaluate	Initially and periodically during task	Not Applicable

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).
[d] Noise monitoring and audiometric testing also required.

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5% LEL	1.5 lpm reg direct tubing

5.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling for lead may be required when dust action levels are exceeded. Contact the HSM immediately if this action levels is exceeded.

6 Decontamination

(Reference CH2M HILL SOP HS-13, *Decontamination*)

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Outer-glove removal
- Body-suit removal
- Inner-glove removal
- Respirator removal
- Hand wash/rinse
- Face wash/rinse
- Shower ASAP
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

Heavy Equipment

- Power wash
- Steam clean
- Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

7 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

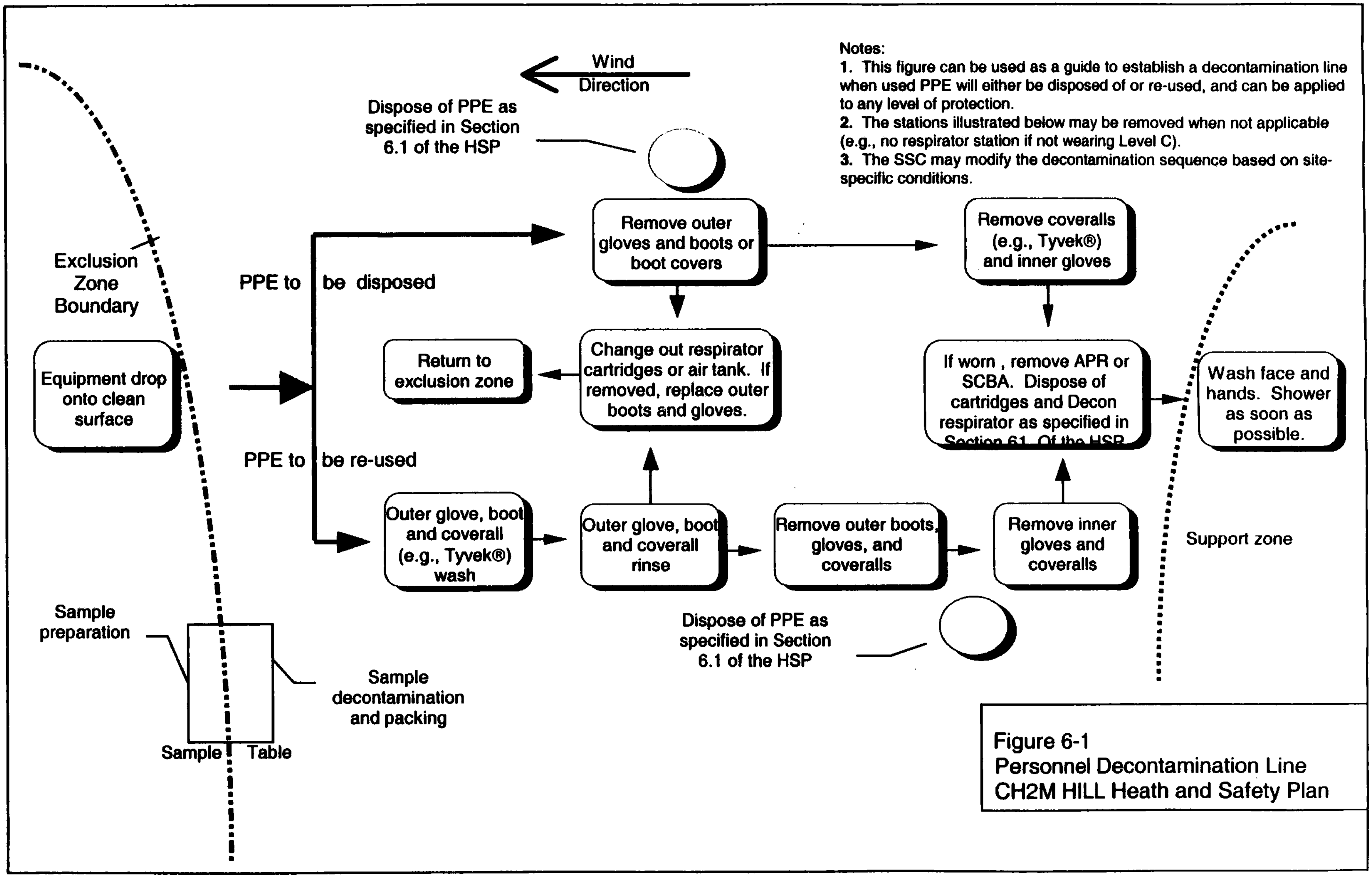


Figure 6-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

8 Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HS-11, *Site Control*)

- The SSC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL SOP HS-71, *OSHA Postings*.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SCC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HS-19, *Site-Specific Written Safety Plans)*

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

9 Emergency Response Plan

(Reference CH2M HILL, SOP HS-12, *Emergency Response*)

9.1 Pre-Emergency Planning

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.

The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Trailer
Eye Wash	Support & Decon Zone/Field Trailer
Potable water	Support & Decon Zone/Field Trailer
Bloodborne-pathogen kit	Support Zone/Field Trailer

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

9.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 9.8 (e.g., 911).
- The SCC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 9.7.

9.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SSC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SSC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SSC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SSC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

9.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

9.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

10 Approval

This site-specific Health and Safety Plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

10.1 Original Plan

Written By: Juliana Hess/NJO **Date: 05/22/2002**

Approved By: Steve Beck **Date: 06/12/2002**

Steven J. Beck

10.2 Revisions

Revisions Made By: **Date:**

Revisions to Plan:

Revisions Approved By: **Date:**

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11 Attachments

Attachment 1: **Employee Signoff Form**
Attachment 2: **Project-Specific Chemical Product Hazard Communication Form**
Attachment 3: **Chemical-Specific Training Form**
Attachment 4: **Emergency Contacts**
Attachment 5: **Project H&S Forms/Permits**
Attachment 6: **Project Activity Self-Assessment Checklists**
Attachment 7: **Applicable Material Safety Data Sheets**
Attachment 8: **Facts about Ticks**

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 1

Employee Signoff Form

CH2MHILL

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

- The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: Diamond Head Oil Refinery **Project Number**: 173044

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

Project-Specific Chemical Product Hazard Communication Form

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: Diamond Head Refinery **Project Number:** 173044

MSDSs will be maintained at the following location(s): Field Trailer

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Methane	1 liter, compressed	Support Zone			
Isobutylene	1 liter, compressed	Support Zone			
Pentane	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Sulfuric Acid	< 500 ml	Support Zone / sample bottles			
Sodium hydroxide	< 500 ml	Support Zone / sample bottles			
Methanol	< 1 Gallon	Support/Decon Zones			
Hexane	< 1 Gallon	Support/Decon Zones			
PH buffers	< 500 ml	Support Zone			
MSA Sanitizer	< 1 liter	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

Chemical-Specific Training Form

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # : 173044
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 4

Emergency Contacts

CH2MHILL

Emergency Contacts

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical - 911	**Medi-T Inc** 815 Summer Ave Newark, NJ 07104 Phone: 973-481-4004	**CH2M HILL Medical Consultant** Health Resources Dr. Jerry H. Berke, M.D., M.P.H. 600 West Cummings Park, Suite 3400 Woburn, MA 01801-6350 1-781-938-4653 or 1-800-350-4511 (After hours calls will be returned within 20 minutes)
Fire/Spill -- 911	**Kearny Fire Dept** 110 Maple St Kearny, NJ 07032 Phone: 201-991-1402	**Corporate Director Health, Safety & Environment** Name: Dave McCormack/SEA Phone: 425/453-5000 **24-hour emergency beeper: 888-444-1226**
Police - 911	**Kearny Police Dept** 237 Laurel Ave Kearny, NJ 07032 Phone : 201-998-1313	**Regional Health & Safety Program Manager (RHSPM)** Name: John Longo/NJO Phone: 973/316-0159 ext. 4543 Cell Ph: 973-449-3587

Safety Coordinator (SC) Name: Andy Judd/NJO Phone: 973-316-9300	**Regional Human Resources Department** Name: Cindy Bauder/WDC Phone: 703/471-1441 ext. 4243
Project Manager (PM) Name: Juliana Hess/NJO Phone: 973/316-0159 ext. 4547	**Corporate Human Resources Department** Name: Pete Hannan/COR Phone: 303/771-0900
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**Worker's Compensation:** Contact Regional HR dept. to have form completed or contact Julie Zimmerman after hours: 303/664-3304
CH2M HILL Emergency Number for Shipping Dangerous Goods Phone: 800/255-3924	**Automobile Accidents:** Rental: Carol Dietz/COR 303/713-2757 CH2M HILL owned vehicle: Zurich Insurance Co. 800/987-3373

Contact the PM. Generally, the PM will contact relevant government agencies.

Facility Alarms: Horn Blast (3x) from field vehicle

Evacuation Assembly Area(s): To be determined and communicated to all staff by the Site Safety Coordinator (SCC)

Facility/Site Evacuation Route(s): To be determined/communicated to all staff by the Site Safety Coordinator (SCC)

Hospital

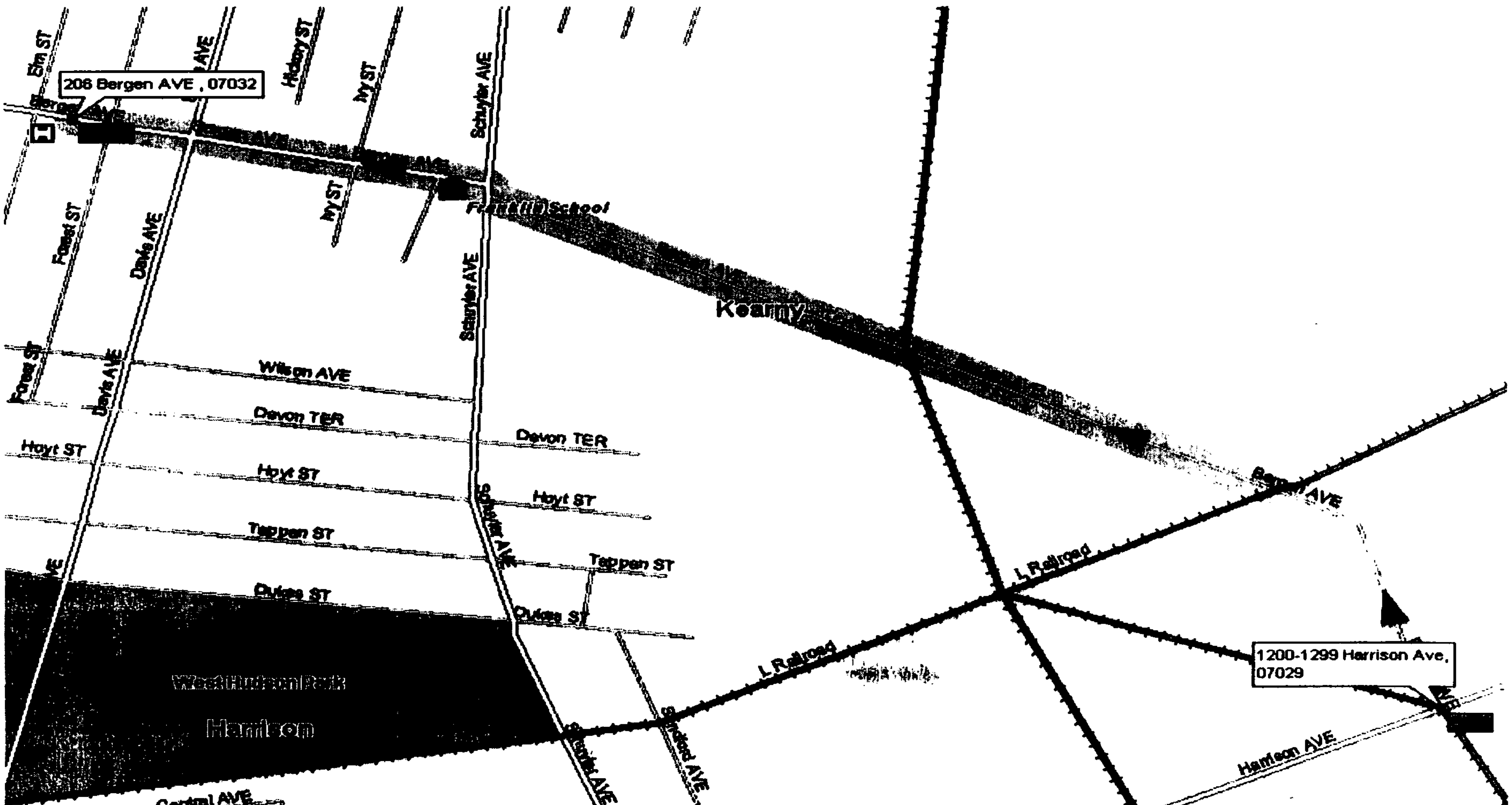
West Hudson Hospital
206 Bergen Ave
Kearny, NJ 07032

Hospital Phone #: 201-955-7000

Directions to Hospital

1. **Go Northwest on Bergen Ave................................0.7 miles**
2. **Turn Right on Schuyler Ave..................................0.1 miles**
3. **Turn Left on Bergen Ave.......................................0.3 miles**

Total 1.0 miles 2 minutes



CH2M HILL HEALTH AND SAFETY PLAN

Attachment 5

Project H&S Forms and Permits

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 6

Self-Assessment Checklists

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SC may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: ______________________________ Project No.: ______________

Location: ______________________________ PM: ______________

Auditor: ______________________ Title: ______________________ Date: __________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling HS&E requirements
Subcontractors Name: ______________________________

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-35.

SECTION 1	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (3.1)				
1. Only authorized personnel operating drill rig	☐	☐	☐	☐
2. Personnel cleared during rig startup	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7. Smoking is prohibited around drilling operation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
9. Aquifer evaluated for contamination, sole source and wellhead protection	☐	☐	☐	☐
10. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
11. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (3.2.2)				
12. Location of underground utilities identified	☐	☐	☐	☐
13. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
14. Drilling pad established, when necessary	☐	☐	☐	☐
15. Drill rig leveled and stabilized	☐	☐	☐	☐
DRILL RIG TRAVEL (3.2.3)				
16. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
17. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
18. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
19. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
20. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (3.2.4)				
21. Kill switch clearly identified and operational	☐	☐	☐	☐
22. All machine guards are in place	☐	☐	☐	☐
23. Rig ropes not wrapped around body parts	☐	☐	☐	☐
24. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
25. Drill operation stopped during inclement weather	☐	☐	☐	☐
26. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
27. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG MAINTENANCE (3.2.5)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐
DRILLING WASTE MANAGEMENT (3.2.6)				
35. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (3.2.7)				
36. Waste disposed of according to HSP and RCRA regulations	☐	☐	☐	☐
37. Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐
FORMS/PERMITS (3.3)				
38. Driller license/certification and drill rig permit obtained	☐	☐	☐	☐
39. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
40. Water withdrawal permit obtained, where required	☐	☐	☐	☐
41. Dig permit obtained, where required	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

CH2MHILL

HS&E Self-Assessment Checklist - EARTHMOVING EQUIPMENT

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to the hazards of earthmoving equipment operations, 2) CH2M HILL employees are operating earthmoving equipment, and/or 3) CH2M HILL provides oversight of a subcontractor operating earthmoving equipment.

The CH2M HILL Safety Coordinator may consult with subcontractors operating earthmoving equipment when completing this checklist, but shall not direct the means and methods of equipment operations nor direct the details of corrective actions. Earthmoving equipment subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Project Name: ______________________ Project No.: ____________

Location: ______________________ PM: ____________

Auditor: ______________ Title: ______________ Date: __________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to earthmoving equipment hazards (complete Section 1).
☐ Evaluate CH2M HILL employees operating earthmoving equipment (complete entire checklist).
☐ Evaluate CH2M HILL subcontractor's compliance with earthmoving equipment safety requirements (complete entire checklist). Subcontractors Name: ______________________

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the earthmoving equipment subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-27.

SAFE WORK PRACTICES (3.1) — SECTION 1	Yes	No	N/A	N/O
1. Personnel maintaining safe distance from operating equipment	☐	☐	☐	☐
2. Positioning personnel in close proximity to operating equipment is avoided	☐	☐	☐	☐
3. Personnel wearing high-visibility and/or reflective vests when close to operating equipment	☐	☐	☐	☐
4. Personnel approach operating equipment safely	☐	☐	☐	☐
5. Personnel riding only in seats of equipment cab and using seat belts	☐	☐	☐	☐
6. Personnel not positioned under elevated portions of equipment	☐	☐	☐	☐
7. Personnel not positioned under hoisted loads	☐	☐	☐	☐
8. Personnel not hoisted by equipment	☐	☐	☐	☐
9. Personnel do not to approach equipment that has become electrically energized	☐	☐	☐	☐
10. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

EQUIPMENT SAFETY REQUIREMENTS SECTION 2 PRIOR TO OPERATING EQUIPMENT (3.2.1)	Yes	No	N/A	N/O
11. Only qualified and authorized personnel operating equipment	☐	☐	☐	☐
12. Daily safety briefing/meeting conducted with equipment operators	☐	☐	☐	☐
13. Daily inspection of equipment conducted and documented	☐	☐	☐	☐
14. Modifications and attachments used approved by equipment manufacturer	☐	☐	☐	☐
15. Backup alarm or spotter used when backing equipment	☐	☐	☐	☐
16. Operational horn provided on bi-directional equipment	☐	☐	☐	☐
17. Seat belts are provided and used	☐	☐	☐	☐
18. Rollover protective structures (ROPS) provided	☐	☐	☐	☐
19. Braking system capable of stopping full payload	☐	☐	☐	☐
20. Headlights and taillights operable when additional light required	☐	☐	☐	☐
21. Brake lights in operable condition	☐	☐	☐	☐
22. Cab glass provides no visible distortion to the operator	☐	☐	☐	☐
23. All machine guards are in place	☐	☐	☐	☐
24. Hauling equipment (dump trucks) provided with cab shield or canopy	☐	☐	☐	☐
25. Dump truck beds provided with positive means of support during maintenance or inspection	☐	☐	☐	☐
26. Dump truck operating levers provided with latch to prevent accidental dumping	☐	☐	☐	☐
27. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
EQUIPMENT PLACEMENT (3.2.2)				
28. Equipment position on firm/level surface, outriggers used	☐	☐	☐	☐
29. Location of underground utilities identified	☐	☐	☐	☐
30. Safe clearance distance maintained while working under overhead power lines	☐	☐	☐	☐
31. Safe distance is maintained while traveling under power lines	☐	☐	☐	☐
32. Warning system used to remind operator of excavation edge	☐	☐	☐	☐
33. Unattended equipment visibly marked at night	☐	☐	☐	☐
34. Tools lowered/parking brake set when not in use, wheels chocked when parked on incline	☐	☐	☐	☐
EQUIPMENT OPERATION (3.2.3)				
35. Equipment operated on safe roadways and grades	☐	☐	☐	☐
36. Equipment operated at safe speed	☐	☐	☐	☐
37. Operators maintain unobstructed view of travel path	☐	☐	☐	☐
38. Equipment not operated during inclement weather, lightning storms	☐	☐	☐	☐
39. Equipment started and moved safely	☐	☐	☐	☐
40. Operators keep body parts inside cab during operation	☐	☐	☐	☐
41. Vehicle occupants in safe position while loading/unloading	☐	☐	☐	☐
42. Signal person visible to operator when required	☐	☐	☐	☐
43. Equipment used for hoisting done according to equipment manufacturer specifications	☐	☐	☐	☐
44. Lifting and hauling capacities are not exceeded	☐	☐	☐	☐
EQUIPMENT MAINTENANCE (3.2.4)				
45. Defective components repaired immediately	☐	☐	☐	☐
46. Suspended equipment or attachments supported prior to work under or between	☐	☐	☐	☐
47. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
48. Tires on split rims removed using safety tire rack or cage	☐	☐	☐	☐
49. Good housekeeping maintained on and around equipment	☐	☐	☐	☐
EXCAVATING AT HAZARDOUS WASTE SITES (3.2.5)				
50. Waste disposed of according to HSP/FSI	☐	☐	☐	☐
51. Appropriate decontamination procedures being followed, per HSP/FSI	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________________ Project Manager: ______________________________

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: (1) CH2M HILL employees enter excavations (complete Sections 1 and 3), and/or (2) CH2M HILL oversight of an excavation subcontractor is required (complete entire checklist).

SC may consult with excavation subcontractors when completing this checklist, but shall not direct the means and methods of excavation operations nor direct the details of corrective actions. Excavation subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Conditions considered imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazardous area until corrected.

Project Name: ______________________ Project No.: ____________

Location: ______________________ PM: ____________

Auditor: ____________ Title: ____________ Date: ____________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to excavation hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with excavation HS&E requirements
Subcontractor Name: ______________________

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the excavation subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-32.

SECTION 1	Yes	No	N/A	N/O
EXCAVATION ENTRY REQUIREMENTS (4.1)				
1. Personnel have completed excavation safety training	☐	☐	☐	☐
2. Competent person has completed daily inspection and has authorized entry	☐	☐	☐	☐
3. Personnel are aware of entry requirements established by competent person	☐	☐	☐	☐
4. Protective systems are free from damage and in stable condition	☐	☐	☐	☐
5. Surface objects/structures secured from falling into excavation	☐	☐	☐	☐
6. Potential hazardous atmospheres have been tested and found to be at safe levels	☐	☐	☐	☐
7. Precautions have been taken to prevent cave-in from water accumulation in the excavation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist - EXCAVATIONS

SECTION 2	Yes	No	N/A	N/O

GENERAL (4.2.1)				
9. Daily safety briefing/meeting conducted with personnel	☐	☐	☐	☐
10. Excavation and protective systems adequately inspected by competent person	☐	☐	☐	☐
11. Defective protective systems or other unsafe conditions corrected before entry	☐	☐	☐	☐
12. Guardrails provided on walkways over excavation 6' (1.8m) or deeper	☐	☐	☐	☐
13. Barriers provided at excavations 6' or deeper when excavation not readily visible	☐	☐	☐	☐
14. Barriers or covers provided for wells, pits, shafts, or similar excavation 6' (1.8 m) or deeper	☐	☐	☐	☐
15. Earthmoving equipment operated safely (use earthmoving equipment checklist in HS-27)	☐	☐	☐	☐
PRIOR TO EXCAVATING (4.2.2)				
16. Dig permit obtained where required by client/facility	☐	☐	☐	☐
17. Location of underground utilities and installations identified	☐	☐	☐	☐
18. Excavation area evaluated for OE/UXO hazards	☐	☐	☐	☐
19. Soils characterized prior to excavation where contamination may be present	☐	☐	☐	☐
20. USDA (or local equivalent) soil permit obtained for soil transport, where required	☐	☐	☐	☐
21. Excavation area checked for wetlands, endangered species, cultural/historic resources	☐	☐	☐	☐
22. ACOE/CWA 404 (or local equivalent) permit obtained for wetlands, where required	☐	☐	☐	☐
23. Stockpile management plan prepared	☐	☐	☐	☐
24. Waste discharge/NPDES (or local equivalent) permit obtained for excavation dewatering	☐	☐	☐	☐
25. Stormwater pollution prevention or erosion & sediment control plan prepared, where required)	☐	☐	☐	☐
EXCAVATING ACTIVITIES (4.2.3)				
26. Rocks, trees, and other unstable surface objects removed or supported	☐	☐	☐	☐
27. Exposed underground utility lines supported	☐	☐	☐	☐
28. Undermined surface structures supported or determined to be in safe condition	☐	☐	☐	☐
29. Warning system used to remind equipment operators of excavation edge	☐	☐	☐	☐
30. Stockpile, excavation covers, liners, silt fences in place, where required	☐	☐	☐	☐
31. Fugitive dust suppressed	☐	☐	☐	☐
EXCAVATION ENTRY (4.2.4)				
32. Trenches > 4' (1.2 m) deep provided with safe means of egress within 25' (7.6 m)	☐	☐	☐	☐
33. Structure ramps designed and approved by competent person	☐	☐	☐	☐
34. Potential hazardous atmospheres tested prior to entry	☐	☐	☐	☐
35. Rescue equipment provided where potential for hazardous atmospheres exists	☐	☐	☐	☐
36. Ventilation used to control hazardous atmospheres and air tested frequently	☐	☐	☐	☐
37. Appropriate respiratory protection used when ventilation does not control hazards	☐	☐	☐	☐
38. Precautions taken to prevent cave-in from water accumulation in excavation	☐	☐	☐	☐
39. Precautions taken to prevent surface water from entering excavation	☐	☐	☐	☐
40. Protection provided from falling/rolling material from excavation face	☐	☐	☐	☐
41. Spoil piles, equipment, materials restrained or kept at least 2' (61 cm) from excavation edge	☐	☐	☐	☐
EXCAVATION PROTECTIVE SYSTEMS (4.2.5)				
42. Protective systems used for excavations 5' (1.5 m) or deeper, unless stable rock	☐	☐	☐	☐
43. Protective systems for excavation deeper than 20' (6.1 m) designed by registered PE	☐	☐	☐	☐
44. If soil unclassified, maximum allowable slope is 34 degrees	☐	☐	☐	☐
45. Protective systems free from damage	☐	☐	☐	☐
46. Protective system used according to manufacturer's recommendations and not subjected to loads exceeding design limits	☐	☐	☐	☐
47. Protective system components securely connected to prevent movement or failure	☐	☐	☐	☐
48. Cave-in protection provided while entering/exiting shielding systems	☐	☐	☐	☐
49. Personnel removed from shielding systems when installed, removed, or vertical movement	☐	☐	☐	☐

SECTION 2 (Continued)	**Yes**	**No**	**N/A**	**N/O**

PROTECTIVE SYSTEM REMOVAL AND BACKFILLING (4.2.6)				
50. Protective system removal starts and progresses from excavation bottom	☐	☐	☐	☐
51. Protective systems removed slowly and cautiously	☐	☐	☐	☐
52. Temporary structure supports used if failure of remaining components observed	☐	☐	☐	☐
53. Backfilling taking place immediately after protective system removal	☐	☐	☐	☐
54. Backfill certified clean when required by client or local regulation	☐	☐	☐	☐
EXCAVATING AT HAZARDOUS WASTE SITES (4.2.7)				
55. Waste disposed of according to HSP and RCRA regulations	☐	☐	☐	☐
56. Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐
EXCAVATING AT POTENTIAL ORDNANCE EXPLOSIVES SITES (4.2.8)				
57. OE plan prepared and approved	☐	☐	☐	☐
58. OE/UXO avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
59. Personnel remain inside the marked boundary	☐	☐	☐	☐
60. Earthmoving equipment does not excavate closer than 1' (30.5 cm) to anomalies	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________ Project Manager: ______________________

H&S Self-Assessment Checklist—CRANES, HOISTS AND RIGGING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are exposed to crane, hoist and rigging hazards (complete Section 1 and 3) and/or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to crane, hoist and rigging hazards (complete entire checklist).

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of crane, hoist and rigging operations nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: ______________________________ Project No.: ______________

Location: ______________________________ PM: ______________

Auditor: ____________________ Title: ____________________ Date: __________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to crane, hoist and rigging hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with crane, hoist and rigging requirements
Subcontractors Name: ______________________________

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-44.

SECTION 1

SAFE WORK PRACTICES (3.1)	Yes	No	N/A	N/O
1. Individuals operating cranes and hoists of any type are certified operators	☐	☐	☐	☐
2. Cranes have current annual inspection and operations manual with load charts on site	☐	☐	☐	☐
3. Swing radius of cranes are guarded and barricaded	☐	☐	☐	☐
4. Competent person inspects crane daily	☐	☐	☐	☐
5. Pre-lift meetings conducted with all parties involved in crane operations	☐	☐	☐	☐
6. Cranes used to lift vertically only	☐	☐	☐	☐
7. Adequate distance maintained between cranes parts and overhead power lines	☐	☐	☐	☐
8. Dedicated signal person assigned to signal operator	☐	☐	☐	☐
9. Cranes do not swing over live roadways, railways, processes, or occupied buildings	☐	☐	☐	☐
10. Critical lifts have written lifting/rigging plan	☐	☐	☐	☐
11. No personnel permitted on or under loads lifted by crane. Tag lines used to control load	☐	☐	☐	☐
12. Manufacturers specifications and limitations for hoists followed	☐	☐	☐	☐
13. Personnel not permitted to ride on material hoists	☐	☐	☐	☐
14. Weather conditions considered when lifting operations performed	☐	☐	☐	☐
15. All rigging used as intended, inspected, stored, protected and supervised.	☐	☐	☐	☐
16. No fabrication, modifications, or additions to rigging made without testing and approval	☐	☐	☐	☐

SECTION 2

	Yes	No	N/A	N/O
CRANES: GENERAL (3.2.1)				
17. The competent person inspects all cranes, hoists, and rigging prior to use	☐	☐	☐	☐
18. Frequent and periodic inspections have been completed for all cranes to be used	☐	☐	☐	☐
19. Crane ropes and hooks have been inspected by an authorized person	☐	☐	☐	☐
20. All guards and safety devices installed and equipment removed after maintenance	☐	☐	☐	☐
21. A load-rating chart is easily visible to the seated operator	☐	☐	☐	☐
22. A designated person has been assigned to signal the operator when visibility is obstructed	☐	☐	☐	☐
23. Hand signals to crane operators are those prescribed by ANSI	☐	☐	☐	☐
24. All outriggers are deployed and seated	☐	☐	☐	☐
25. The tires of truck mounted cranes are off the ground when the outriggers are seated	☐	☐	☐	☐
26. Cranes are equipped with load limiting devices and boom angle indicator	☐	☐	☐	☐
27. Cabs of cranes have adequate access and kept clean of loose tools, cans, and waste	☐	☐	☐	☐
28. Cranes are equipped with a 5 BC or higher fire extinguisher	☐	☐	☐	☐
29. All windows in cabs are safety glass that does not interfere with the safe operation	☐	☐	☐	☐
30. All machinery operating on rails, tracks, or trolleys has stops/limiting and overspeed devices	☐	☐	☐	☐
31. Moving parts on the crane that employees are exposed to are guarded	☐	☐	☐	☐
CRANES: POSITIONING (3.2.2)				
32. Cranes operated near live power lines will maintain minimum distance from the lines	☐	☐	☐	☐
33. Adequate clearance must be maintained between a crane and obstructions	☐	☐	☐	☐
34. The crane is level and blocked properly	☐	☐	☐	☐
35. Swing radius of crane has been barricaded to prevent exposure to struck against/crush hazard	☐	☐	☐	☐
36. Exhaust pipes are guarded from employee contact	☐	☐	☐	☐
CRANES: OPERATION (3.2.3)				
37. Operator tests brakes when load is near rated capacity of lift	☐	☐	☐	☐
38. Sheaves are guarded or warning sign provided to identify hazard	☐	☐	☐	☐
39. Load or boom not lowered to where less than two full wraps of rope remain on drum	☐	☐	☐	☐
40. If two or more cranes are to be used to lift one load, a designated person is responsible for analyzing, instructing, rigging and signaling movement of the load	☐	☐	☐	☐
41. Cranes not operated without full amount of ballast or counterweight	☐	☐	☐	☐
42. Tag lines are used to control suspended load	☐	☐	☐	☐
43. Sudden acceleration or deceleration of load is avoided	☐	☐	☐	☐
44. Loads are not to be passed over personnel or facilities	☐	☐	☐	☐
45. No personnel are allowed to ride the load	☐	☐	☐	☐
46. Suspended loads are not left unattended	☐	☐	☐	☐
47. Lines are not allowed to twist around each other	☐	☐	☐	☐
HOISTS: GENERAL (3.2.4)				
48. Manufacturer's specifications and limitations are followed	☐	☐	☐	☐
49. Load capacities, operating speeds, and special warnings or instructions are posted on hoists	☐	☐	☐	☐
50. Hoist ropes are installed in accordance with the wire rope manufacturers' recommendations	☐	☐	☐	☐
51. Live booms are not installed on hoists	☐	☐	☐	☐
52. Operating rules are posted at the operator's station of hoists	☐	☐	☐	☐
53. No person will ride on material hoists except for inspection and maintenance	☐	☐	☐	☐
54. All entrances of the hoistways are protected by substantial gates or bars	☐	☐	☐	☐
55. Overhead protective coverings are provided on the top of every material host cage or platform	☐	☐	☐	☐
56. All hoistway entrance bars and gates are painted with diagonal contrasting colors	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
RIGGING: GENERAL (3.2.5)				
57. The rigging equipment is not used in excess of the rated capacity of the weakest component	☐	☐	☐	☐
58. The rigging competent person has inspected all rigging equipment prior to use on each shift and as necessary during its use	☐	☐	☐	☐
59. Documentation of proof testing is available for rigging equipment that has been repaired	☐	☐	☐	☐
60. Rigging equipment has not been shortened with knots, bolts or other makeshift devices	☐	☐	☐	☐
61. Rigging equipment, when not in use, is removed from the work area	☐	☐	☐	☐
62. Rigging equipment has been load tested annually by a competent person and documented	☐	☐	☐	☐
63. All hooks used according to manufacturer's recommendations or tested to twice SWL	☐	☐	☐	☐
64. Special rigging and hoisting devices are marked and proof tested prior to initial use	☐	☐	☐	☐
RIGGING: EQUIPMENT (3.2.6)				
65. Protruding end strands of wire rope have been covered or blunted	☐	☐	☐	☐
66. Wire rope not used if the rope shows any sign of excessive wear, corrosion, or defect	☐	☐	☐	☐
67. No wire rope slings are used if more than one wire in a lay is broken in the end fitting	☐	☐	☐	☐
68. Splices in rope slings are made in accordance with manufacturer's and regulatory specs	☐	☐	☐	☐
69. Synthetic web slings removed from service if showing any sign of damage	☐	☐	☐	☐
70. No job hooks, links, or makeshift fasteners, formed from bolts, rods, etc., are used	☐	☐	☐	☐
71. Alloy steel chains have identification stating size, grade, rated capacity and reach	☐	☐	☐	☐
72. Manual coupling links or low carbon repair links not used to repair broken lengths of chain	☐	☐	☐	☐
73. Shackles and hooks are constructed of forged alloy steel with the identifiable load rating	☐	☐	☐	☐
RIGGING: USE (3.2.7)				
74. Rigging not pulled from under a resting load				
75. Sling(s) is placed in center bowl of hook.	☐	☐	☐	☐
76. Sharp edges are "packed" to prevent cutting or damaging the rope or slings	☐	☐	☐	☐
77. Nylon, polyester, polypropylene web slings or web slings with aluminum fittings will not be used where fumes, vapors, sprays, mists or liquids of acids, caustics or phenolics are present	☐	☐	☐	☐
78. Natural or synthetic fiber rope slings used within acceptable operating temperature	☐	☐	☐	☐
79. U-bolts used to form wire rope eyes are of proper amount and spacing	☐	☐	☐	☐
80. U-bolts are installed so that the "U" section is in contact with the dead end of the rope	☐	☐	☐	☐
81. When more than one sling is used, or the sling angle is altered, the load has been calculated to assure that the safe working load is not exceeded.	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________________ Project Manager: ______________________________

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are exposed to welding and cutting hazards and/or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to welding and cutting hazards.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of welding and cutting operations nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: ______________________ Project No.: ____________

Location: ______________________ PM: ____________

Auditor: ____________ Title: ____________ Date: ________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to welding and cutting hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with welding and cutting requirements
Subcontractors Name: ______________________

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-63.

SECTION 1

SAFE WORK PRACTICES (3.1)

	Yes	No	N/A	N/O
1. CH2M HILL employees have completed Welding and Cutting training	☐	☐	☐	☐
2. Welding and cutting personnel have been properly trained and qualified	☐	☐	☐	☐
3. Work area inspected by the authorized person	☐	☐	☐	☐
4. Suitable fire extinguishing equipment is available	☐	☐	☐	☐
5. Flame-resistant blankets used to control sparks from travelling to lower levels	☐	☐	☐	☐
6. Leaking valves of cylinders repaired or tagged and removed from service	☐	☐	☐	☐
7. Top of cylinder or manifold kept clear to prevent damage and allow quick closing of valve	☐	☐	☐	☐
8. Flow gauges and regulators on cylinders inspected prior to use and removed when not in use	☐	☐	☐	☐
9. Hose, leads, and cables covered, elevated, or protected from damage.	☐	☐	☐	☐
10. Fuel gas and oxygen cylinders in storage separated or protected with fire barrier	☐	☐	☐	☐
11. Flash arresters are installed at the torch handle	☐	☐	☐	☐
12. Hot electrode holders not dipped in water to cool	☐	☐	☐	☐
13. Arc welding electrodes not struck against cylinders to strike an arc	☐	☐	☐	☐
14. Arc welding or cutting work shielded with screens to prevent employees from arc	☐	☐	☐	☐
15. Proper ventilation provided to maintain exposure to contaminants below PEL	☐	☐	☐	☐
16. Arc welding equipment exposed to unusual service conditions is task designed	☐	☐	☐	☐

SECTION 2

	Yes	No	N/A	N/O
COMPRESSED GAS CYLINDERS (3.2.1)				
17. Cylinders being transported have valve protection caps installed and in vertical position	☐	☐	☐	☐
18. Cylinders hoisted by cradle, slingboard or pallet designed to do so and not by valve cap	☐	☐	☐	☐
19 Cylinders kept from being knocked over by a chain, truck or steadying device	☐	☐	☐	☐
20. Oxygen cylinders are separated from fuel-gas cylinders by 20 feet or a 5 foot fire barrier	☐	☐	☐	☐
21. Cylinders stored indoors in a well ventilated location, where they won't be knocked over	☐	☐	☐	☐
22. Cylinders in use are kept away from sparks, flames or slag or are shielded	☐	☐	☐	☐
23. Valves are "cracked" prior to attaching regulators	☐	☐	☐	☐
24. Cylinders are not placed where they can become part of an electrical circuit	☐	☐	☐	☐
25. Oxygen or fuel-gas cylinders are outside of confined spaces	☐	☐	☐	☐
26. Cylinders, valves, couplings, regulators and valves are free of grease and oil	☐	☐	☐	☐
27. Frozen cylinders are thawed with warm water and not boiling water	☐	☐	☐	☐
28. Fuel-gas cylinders are opened not more than 1.5 turns for quick closing	☐	☐	☐	☐
29. Damaged, defective or leaking cylinders have been removed from service	☐	☐	☐	☐
30. Only owner or authorized agent refills cylinders or attempts to mix gasses in cylinder	☐	☐	☐	☐
WELDING AND CUTTING EQUIPMENT (3.2.2)				
31. Fuel-gas and oxygen manifolds are labeled with one inch letters or sign to identify substance	☐	☐	☐	☐
32. Fuel-gas and oxygen manifolds are working properly & located in a well ventilated open area	☐	☐	☐	☐
33. Manifold and header hoses capped when not in use	☐	☐	☐	☐
34. Flash arresters are used on acetylene cylinders connected together	☐	☐	☐	☐
35. Fuel-gas and oxygen hoses are clearly marked, not interchangeable and free of grease and oil	☐	☐	☐	☐
36. Parallel sections of hose taped together have no more than 4 inches covered per foot	☐	☐	☐	☐
37. Torches and hoses are inspected at the beginning of each shift	☐	☐	☐	☐
38. Hoses connections are designed to be disconnected with a rotary motion, not straight pull	☐	☐	☐	☐
39. Hoses are stored in a ventilated box	☐	☐	☐	☐
40. Torches are lit with friction lighters, not open flames or hot work	☐	☐	☐	☐
ARC WELDING AND CUTTING (3.2.3)				
41. Only manual electrode holders designed for arc welding are used	☐	☐	☐	☐
42. Only cable free of repair/splices < 10 ft. from cable attachment to electrode holder are used	☐	☐	☐	☐
43. All parts of the welding and cutting equipment that are gripped are fully insulated	☐	☐	☐	☐
44. All welding and cutting cables are fully insulated	☐	☐	☐	☐
45. Pipelines containing flammable gases or liquids are not used as a ground return	☐	☐	☐	☐
46. All ground connections have been inspected for mechanical strength and current capacity				
47. Frame of arc welding/cutting machine is grounded.				
48. When electrode holders are unattended, the electrode is removed	☐	☐	☐	☐
49. Hot electrode holder are not be dipped in water to cool	☐	☐	☐	☐
50. When welding or cutting is stopped or equipment is moved, power is shut off	☐	☐	☐	☐
51. Before starting welding and cutting operations the equipment is inspected	☐	☐	☐	☐
52. The frame or case of the welding machine is grounded (except engine driven machines)	☐	☐	☐	☐
53. Employees in the vicinity are shielded from the direct rays of the arc, or given filter lenses	☐	☐	☐	☐
54. Inert gas welding employees are completely covered to prevent skin burns	☐	☐	☐	☐
55. Chlorinated solvents are >200 feet away and surfaces prepared w/ solvents are dry prior	☐	☐	☐	☐
TOXIC FUMES AND GASES (3.2.4)				
56. Mechanical or local exhaust ventilation is used when welding or cutting in a confined space	☐	☐	☐	☐
57. Mechanical ventilation is capable of keeping fumes and smoke below the exposure limits	☐	☐	☐	☐
58. Local exhaust ventilation is close to the work to keep employee below the exposure limits	☐	☐	☐	☐
59. Contaminated air is exhausted into open air clear of the intake	☐	☐	☐	☐
60. Exhausted air is replaced by breathable air, and not oxygen	☐	☐	☐	☐
61. Welding/cutting in confined space on toxic metals is done w/ ventilation or supplied air	☐	☐	☐	☐
62 Welding/cutting in open air on metals outlined in 3.2.4 done with filter or air line respirator	☐	☐	☐	☐
63. Workers exposed to the same atmosphere as welder are protected in the same manner	☐	☐	☐	☐
64. In enclosed spaces, all surfaces covered with preservative coating are stripped at least four inches from the area to be heated, or the worker is protected with an air line respirator	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
FIRE PREVENTION (3.2.5)				
65. Objects to be welded or cut have been moved to a safe location	☐	☐	☐	☐
66. Combustibles have been moved at least 35 feet from welding and cutting	☐	☐	☐	☐
67. Combustibles that cannot be moved are protected from flame, heat and sparks	☐	☐	☐	☐
68. Fire extinguishing equipment is immediately available in the work area	☐	☐	☐	☐
69. Additional trained personnel (fire watch) assigned when normal fire fighting is not sufficient	☐	☐	☐	☐
70. The atmosphere to be welded or cut in is not explosive as verified by air monitoring, as needed	☐	☐	☐	☐
71. Precautions have been taken on the opposite side of walls, floors and ceilings	☐	☐	☐	☐
72. Openings in floors and walls are blocked to prevent sparks from passing through	☐	☐	☐	☐
73. Gas supply can be shut off at some point outside an enclosed space	☐	☐	☐	☐
74. Drums have been filled with water, cleaned or ventilated and tested before welding or cutting	☐	☐	☐	☐
75. Drums, containers or structures have an open vent before heat is applied	☐	☐	☐	☐
76. Surface coatings have been tested for flammability before welding or cutting	☐	☐	☐	☐
77. Flammable coatings have been stripped before welding or cutting	☐	☐	☐	☐
PERSONAL PROTECTIVE EQUIPMENT (3.2.6)				
78. When welding or cutting on surfaces with preservative coatings, respirators used	☐	☐	☐	☐
79. Workers entering a confined space through a small opening wear a full body harness or other suitable device for quick removal in case of an emergency	☐	☐	☐	☐
80. Employees welding or cutting wear the proper eye protective equipment as per Table 1	☐	☐	☐	☐
81. Welders or cutters exposed to other welders arc wear filter goggles under their helmets	☐	☐	☐	☐
82. Exposed employees wearing protective clothing to protect against UV damage	☐	☐	☐	☐
83. Fall protection is provided when working 6 feet or more above lower levels	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________ Project Manager: ______________________

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 7

Material Safety Data Sheets

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 8

Facts about Ticks

Tick-Borne Pathogens

There are 6 notifiable tick-borne pathogens that present a significant field hazard, and in some areas account for more than half of our serious field incidents. These procedures should be applied during any field activity – even those field efforts that are located predominantly in paved areas but with bordering vegetation.

Hazard Control

The methods for controlling exposure to ticks include, in order of most-preferred to least:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or application of pesticide
- Personal protection through use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

Vaccinations are generally not available and preventative antibiotic treatment in non-ill individuals who have received a tick bite is recommended in specific cases only.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants – tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced between 72 and 100% when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant, or licensed pesticide applicator. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary in controlling exposure to ticks. Personal protection must include all of the following steps:

- So that ticks may be seen on your clothing, wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used.
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots.
- Wear long-sleeved shirts, a hat, and high boots.
- Apply DEET repellent to exposed skin or clothing per product label.
- Apply permethrin repellent to the outside of boots and clothing before wearing, per product label.
- Frequently check for ticks and remove from clothing.
- At the end of the day search your entire body for ticks (particularly groin, armpits, neck and head) and shower.
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves anytime ticks are handled.

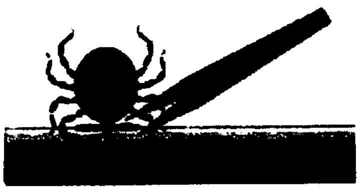
Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid hand-to-face contact, eating, drinking, smoking, etc. when applying or using repellents. Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

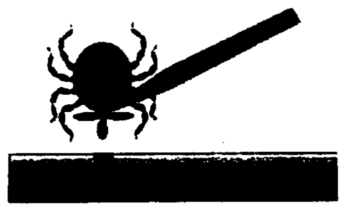
Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only. Even if signs and symptoms of illness are not experienced, report all work related tick bites to your supervisor, Health & Safety (H&S), and Human Resources (HR).

Tick Removal

1. Use fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.

2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.)





3. Do not squeeze, crush, or puncture the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.

4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. You may wish to save the tick for identification in case you become ill. Your doctor can use the information to assist in making an accurate diagnosis. Place the tick in a plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses develop. Even if signs and symptoms of illness are not experienced, report all work related tick bites to your supervisor, H&S, and HR.

Medical treatment for tick-borne infections include antibiotics and other medical interventions. Diagnosis of specific illness includes both clinical and laboratory confirmations. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

Previously infected individuals are not conferred immunity – re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs & symptoms of tick-borne illnesses.

Tick Identification

There are four varieties of hard-bodied ticks that have been associated with transmitting one or more tick-borne pathogens. These tick varieties include:

- Deer (Black Legged) Tick (eastern and pacific)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In the eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture. On the Pacific Coast, the tick habitats are more diverse. Here, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses and Signs & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite – normally hours after initial attachment. The illnesses, presented in approximate order of most common to least, include:

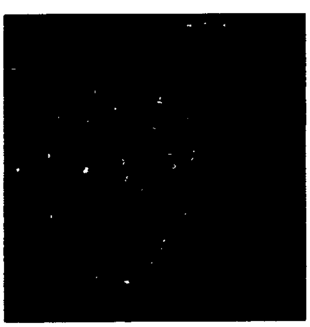
- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. A variety of long-term symptoms may result when untreated, including debilitating effects and death.

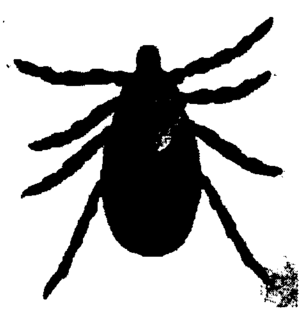
Deer Tick

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)

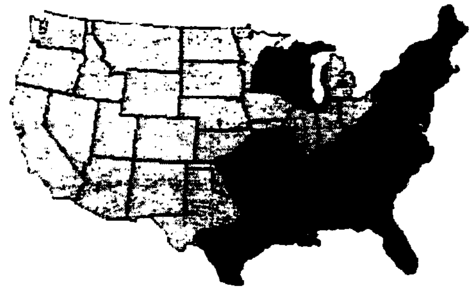
Lone Star Tick



Dog Tick



Rocky Mountain Wood Tick



Distribution of Deer Tick (Green)

Distribution of Pacific Deer Tick (Green)

Distribution of Lone Star Tick (Green)

Distribution of Dog Tick

Distribution of Rocky Mountain Wood Tick (Yellow)

ATTACHMENT D
Data Management Plan for the Diamond Head Oil Site RI/FS

Objective

This plan defines the process for managing existing and new data generated during the Diamond Head Oil site RI/FS. As such, this plan describes the following:

- The responsibilities of the project team for data management
- The Remedial Investigation Data Management System (RIDMS) to be established for the project
- The development of the basemaps onto which the data will be plotted
- The types of data that will be entered into the RIDMS and the process of data entry
- Sample tracking
- The tabular and visual presentations and statistical analyses of the data that will be generated from the RIDMS for use in the RI report, the risk assessments, and FS report

Team Organization and Responsibilities

This data management plan was prepared by the project team members identified below as responsible for the data management process. The following are the team members and their responsibilities for the data management process:

Project Manager (PM) Juliana Hess – Responsible for coordinating with the Data Manager, GIS Lead, and Lead for the preparation of geologic cross sections and groundwater and product thickness levels maps. The PM will establish the sample tracking system at the project onset, track samples, receive analytical results, forward tracking information and received analytical results to the Database Manager, and identifying the format and information to be included in all deliverables. If needed, the PM will prepare an addendum to this plan before the start of the data tabulation and plotting activities in order to identify the data inputs and final format to be used in preparing the various deliverables. This addendum or addenda may in the form of an email providing additional instructions to the leads. As the use of EQuIS is relatively new and there is not a long track record of data management costs using EQuIS, the PM is responsible for tracking the LOE expanded for the various data management activities included under the DE task in order to begin the development of LOE reference points for data management.

Senior Database Consultant Jason Schmitz – Responsible for defining the RIDMS to be used in consultation with the PM and Database Manager, input into the process of establishing RIDMS, and senior input if questions/issues arise during the data management process.

Data Manager Astrid Richardson – Responsible for setting up RIDMS in consultation with the PM and Senior Database Consultant at the beginning of the data management task. Data Manager will also oversee the data management process including data import /manual entry into RIDMS, quality control of the entered data, statistical analyses of the data, and preparation of tables displaying the results. The Data Manager will coordinate with the person responsible for review of the entered data for quality control purposes. Data Manager will forward all deliverables to the PM. All requests for deliverables from RIDMS and the format of these deliverables will be made by the PM to the Data Manager.

GIS Lead To be identified – Responsible for preparing GIS drawings displaying the analytical results (call out boxes and isoconcentration contours). Lead will forward all deliverables to the PM. All requests for deliverables from RIDMS and the format of these deliverables will be made by the PM to the Data Manager.

Lead for Preparation of Geologic Cross Sections, Groundwater Elevation Contour Maps, and Product Thickness Isocontour Maps Jennifer Telford – Responsible for preparing these maps and coordinating with the GIS Lead in order to use the appropriate base map. Lead will forward all deliverables to the PM. All requests for deliverables from RIDMS and the format of these deliverables will be made by the PM to the Data Manager.

RI Lead Andy Judd – responsible for providing weekly the chain of custody (COC) forms and other sampling information to the PM for use in sample tracking. The RI Lead will also be responsible for overseeing the preparation of the boring logs and well construction diagrams using the boring log and well construction diagram computer tools. The information entered into these tools will be imported by the Lead to prepare cross sections of site geology. The RI Lead will also review for technical accuracy and adjust as needed, all cross sections, groundwater elevation contour maps, LNAPL thickness isocontour maps, and chemical isoconcentration maps generated by the RIDMS.

Database Description

The RIDMS for the Diamond Head Oil site RI/FS will be created using a commercial off the shelf (COTS) database called EQuIS (Earthsoft Inc.) and a common Geographic Information System (GIS) such as ArcView. The database will be a relational database that will support a GIS mapping system. The functionality of the database and GIS mapping system will allow consistent storage of the data and its rapid and consistent retrieval and evaluation. The RIDMS thus established to manage the data from this RI could later be supplemented with data gathered during subsequent phases of the project. For example, groundwater-sampling data obtained during the second phase of the investigation, remedial design or long-term remedial alternative monitoring from off-site as well as on-site wells can be entered into RIDMS. Isoconcentration contour and water level contour maps can then be easily generated from RIDMS and used to evaluate contaminant migration and degradation mechanisms over time and thus, the efficacy of the selected remedial action.

The analytical data gathered during the RI at the Diamond Head Oil site will be loaded and retrieved from RIDMS using the EQuIS and GIS toolkits. RockWorks will be used to prepare geologic cross sections, and Surfer/GIS will be used to prepare groundwater elevation contour maps and product thickness isocontour maps. Finally, customized Access-based tools and LogPlot will be used for the preparation of boring logs and well construction diagrams.

The EQuIS relational database, will be used to store, analyze, and report both field and analytical data. The database's two main components, chemistry and geology, are linked together to provide an overall view of the data relationships. Data within EQuIS will be electronically exported to a standard data evaluation and display software application. Due to the dynamic linkages between the data warehouse and the supporting application, once the data is entered and the system is established, it will be possible to efficiently generate plots and cross sections of the analytical data, boring logs, and well construction diagrams using the most current data. EQuIS will also be used to complete statistical analyses of the analytical results, which will be used to perform the human health risk assessment and prepare various tabular presentations of the analytical data (raw data, detected concentrations only, concentrations exceeding preliminary remedial goals - PRGs).

An ArcView project or extension will be available if its use is desired and provides the following functionality: load and display project site basemaps; display sampling station locations and associated sampling data (date, media, results); and perform ad-hoc queries to highlight sampling locations meeting user-entered criteria for sampling (e.g. data by date, sample type, analyte, depth/elevation, result value, or any combination there of). Results would be shown as stations highlighted on the map.

Actual GIS maps displaying the analytical results will be prepared using EQuIS/ArcGIS.

Basemaps

The GIS component of RIDMS will used to create the basemap for the Diamond Head Oil site from an AutoCad map prepared by the surveying subcontractor.

At the beginning of the RI activities, a surveying subcontractor will be tasked to prepare a basemap of the site in Microstation Bentley format. The basemap will include, at a minimum, three points on the site with latitude and longitude coordinates in decimal degrees with an accuracy of 6 decimal places. These points will serve as reference points for importing the basemap from AutoCad into the GIS component of the RIDMS. The basemap will show all site features, Phase 1 RI sampling / well locations, and existing onsite well locations. In addition, the surveying subcontractor will provide the latitude and longitude coordinates of the offsite boring installed as part of this investigation in decimal degrees with an accuracy of 6 decimal places.

The surveying subcontractor will create the basemap at the beginning of the Phase 1 investigation. After it is created, the basemap will be provided to the PM and RI Lead for review and comment. Modifications to the basemap after that will include the addition of the Phase 1 sampling locations after the Phase 1 investigation activities are completed.

Data Entry into RIDMS

The following types of data will be entered into RIDMS:

1. *Soil and groundwater analytical results from CLP and subcontract laboratories.* These data include the results of samples collected by EPA during two site inspections and analyzed through CLP and the results of samples collected during this investigation and also analyzed through CLP. This RI will also obtain samples for engineering evaluations of remedial alternatives (e.g., general water quality and soil geotechnical parameters). The results of these samples will not be entered into the database. The analytical data will be used to generate maps showing the analytical results for the various media in call-out boxes and isoconcentration contour maps.

2. *Boring logs and well construction diagrams prepared using the customized tools.* These will serve as the basis for generating geologic cross sections and fence diagrams.

3. *Water levels from wells and LNAPL thickness measurements.* These will be used to generate groundwater level contour maps showing groundwater flow direction and product thickness measurements maps.

All CLP analytical results for the samples collected during this investigation are expected in EDD electronic format. These results will be imported into EQuIS using the electronic data checker provided by EPA. Only validated analytical data will be imported into RIDMS. Prior to forwarding the received data to the Data Manager for import into the database, the PM or her designee will update the sample tracking sheet and verify that the EDDs reflect the correct sample nomenclature and that for multiple analyzes of the same sample (e.g., diluted and undiluted analyses), the results which are to be used are clearly indicated in the EDD. In cases of multiple analyses where the EPA validator has not indicated which results to use, the PM will contact the RSCC via email to request this determination. The EPA Project Manager will be copied on all such emails as any delays in receiving the data may affect the project schedule.

CH2M HILL will not perform any data validation, modify EPA data validator-assigned data qualifiers, or "cleanup" the provided EDDs to facilitate their import into RIDMS. If any of these are determined to be needed, the project team member who notes the need, will immediately notify the PM who in turn will be responsible for notifying the EPA RSCC and Project Manager of the encountered problems.

Data entry will be accomplished in three separate events. The first event will entail the manual entry of all the existing data. The second data entry event will be after all the soil analytical results are received. This event will start approximately two weeks after the last validated package containing soil data is received in order to allow the PM or her designee time to update the sample tracking sheet and review the EDDs. The PM will notify the Data Manager immediately after receiving the last data package so that the Data Manager can schedule the data import and QC. The last data entry event will start approximately two weeks after the PM receives the last groundwater data package.

The table below provides estimates of the number of Phase 1 RI samples and analytical results to be imported into the database from received CLP EDDs.

Medium	No of samples	Analysis	No of analytes in analysis	Total number of analyte records to be entered into database
Soil	140	VOCs	48	6720
	140	semi-VOCs	64	8960
	140	Pesticides/PCBs	28	3920
	140	metals	23	3220
Groundwater	23	VOCs	48	1104
	23	semi-VOCs	64	1472
	23	Pesticides/PCBs	28	644
	23	metals	23	529
Surface water	12	VOCs	48	576
	12	semi-VOCs	64	768
	12	Pesticides/PCBs	28	336
	12	metals	23	276
Sediment	12	VOCs	48	576
	12	semi-VOCs	64	768
	12	Pesticides/PCBs	28	336
	12	metals	23	276

In addition, the results of approximately 100 samples from EPA's site inspections will be manually entered into the database. An Access- or Excel-based data entry tool will be developed at the start of the existing data entry effort. After entry, all data will be QC-ed before being imported into EQuIS for use.

The total number of analytical records to be entered into the database, are estimated as follows:

- By hand - 16,500 records
- Converted and imported from EDD - 30,500 records

Water levels and LNAPL thickness measurements will be collected on 3 separate occasions:

- After the installation of all wells and piezometers
- At the start of the tidal influence study
- At the start of the groundwater sampling activities

Product thickness measurements will be collected from all wells and piezometers in the shallow groundwater zone where product is observed.

Water levels will be recorded for the following number of wells per zone:

- Shallow groundwater - 15 wells
- Deep groundwater - 4 wells

The surveying subcontractor will be tasked with surveying the vertical elevations and horizontal coordinates for all the existing and new monitoring wells and piezometers after the completing of their installation.

The vertical elevations will include the following:

- The top of the inner well casing (PVC well riser)
- The top of the protective outer casing
- The ground surface

Vertical elevations will be surveyed to an accuracy of 0.01 foot, referenced to National Geodetic Vertical Datum 1929 (NGVD 29) from the nearest datum benchmark (USGS monument). Corrections to the North American Vertical Datum 1988 (NAVD 88) will also be provided for each elevation.

The horizontal coordinates will include the latitude and longitude provided in decimal degrees to an accuracy of 6 decimal places. Horizontal data will be referenced to the North American Datum 1983 (NAD83).

The field team will record the depth to water / depth to product top and bottom from the top of the well / piezometer inner casing.

An Excel spreadsheet will be established at the onset of the water level and product thickness measurements activities. The spreadsheet will contain the vertical elevations and horizontal coordinates of all monitoring wells and piezometers. The spreadsheet will be used to record the field measurements during each of the three above measurement events. The formulas established in the spreadsheet will calculate the water levels and product thickness measurements as the field data is being entered into the spreadsheet. This Excel spreadsheet will be imported into RIDMS in order to prepare the maps showing groundwater elevation and product thickness contours.

Quality control is an important step of the data entry process. After data entry into RIDMS, the data will be printed and QC-ed as follows:

- Phase 1 results - due to the large number of samples, a subset of the analytical results – 10% of the samples -will be QC-ed. The Data Manager is responsible for managing this review. The PM will designate the samples to be QC-ed.

- Existing data – because these data will be manually entered, all data entries will be QC-ed before the data is uploaded into RIDMS. The Data Manager is responsible for managing this review.

- The boring logs, well construction diagrams and water level measurements entered into RIDMS, will be provided to the PM who will coordinate with the RI Lead their review and approval.

Sample Tracking

Sample tracking will be performed using the table in Exhibit D-1. Sample tracking will involve two phases:

- Completing the sample tracking sheet after all the existing data are received from EPA, and

- Periodically updating the sample tracking sheet with the samples collected during this Phase 1 RI.

The PM or her designee is responsible for tracking samples to ensure that the validated analytical results for all samples sent for analysis during this Phase 1 RI are received. At the end of each week of field activities, the RI Lead or his designee will provide the PM with copies of the Chain of Custody forms for the week. The PM or her designee will be responsible for completing the sample tracking table and for tracking the receipt of the validated analytical results for the samples.

Outputs from RIDMS

The outputs from RIDMS are described below.

Tables and statistical analysis

The following tabular data presentations will be generated by RIDMS:

1. Printout of the entire database

Separate tables will be prepared for each class of compounds (VOCs, SVOCs, pesticides, PCBs, and metals) in each of the four sampled media. Samples will be listed in these tables chronologically by sampling location number. At each location, the samples will then be arranged chronologically by depth. The Data Manager will provide drafts of the tables to the PM and RI Lead for review and approval before the final tables are generated.

The following information will be included in each table:

Medium	Information by location	Example
Soil	Sample location	SB-1
	Sample depth (feet below surface)	2-4
	Sample Number	SB-01-2-4
	CLP Sample Number	
	Date sampled	00-00-03
Groundwater	Sample location (includes well depth identifier)	MW-05-S
	Sampling Round	1
	Sample Number	MW-05-S-1
	CLP Sample Number	
	Date sampled	00-00-03
Surface water	Sample location	SW-01
	Sampling Round	1
	Sample Number	SW-01-1
	CLP Sample Number	
	Date sampled	00-00-03
Sediment	Sample location	SD-01
	Sampling Round	1
	Sample Number	SD-01-1
	CLP Sample Number	

Date sampled 00-00-03

2. Printout of the tables for each medium showing only concentrations above detection levels and with the concentrations exceeding standards and criteria highlighted in gray or asterixed or otherwise indicated.

Separate tables will be prepared for each class of compounds (VOCs, SVOCs, pesticides, PCBs, and metals) in each of the four sampled media. Totals of all detected concentrations will also be calculated for organics at each location (VOCs, SVOCs, pesticides, PCBs). Note that the tables for a medium may not contain the same sample stations (e.g., the same list of borings). For example if a boring contains VOCs but not PCBs, the boring will be included in the table presenting the VOC results but not in the table presenting the PCB results.

The PM will coordinate with EPA and the Lead Risk Assessors in order to identify the standards and criteria to use in the tables and will provide them to the Data Manager before the tables are generated.

The Data Manager will provide drafts of the tables to the PM and RI Lead for review and approval before the final tables are generated.

3. Statistical analyses of the results for each medium, which will include the following:

- For each medium, the list of compounds exceeding the standards and criteria at each sampling location
- For each medium and each compound detected in that medium at concentrations exceeding standards and criteria, the locations where these exceedances were noted
- For each medium and each compound detected in that medium at concentrations exceeding standards and criteria, the total number of samples analyzed, the number of samples where the compound was detected, the number of samples containing concentrations exceeding the standards and criteria, and the minimum, maximum and average detected concentration.
- For each medium and each compound detected in that medium at concentrations exceeding standards and criteria, the total number of locations where samples were collected for its analysis, the number of locations where the compound was detected, and the number of locations containing concentrations exceeding the standards and criteria.

The Data Manager will provide drafts of these analyses to the PM and RI Lead for review and approval before the final tables are generated.

4. Statistical calculations to be used during the RA. The Lead Environmental and Human Health Risk Assessors will provide the Data Manager with a list of the statistical calculations needed in order to select the Contaminants of Potential Concern (COPCs) and calculate the risks associated with the site. The Lead Risk Assessors will provide the statistical needs to the Data Manager before the start of the statistical analysis and data tabulation.

The Lead Risk Assessors will use the statistical calculations to estimate the risks associated with the site. All risk calculations will be performed outside of RIDMS.

The Data Manager will provide drafts of the statistical calculations to the Lead Risk Assessors for review and approval before the final values are generated.

Plots

The plots, which will be generated by RIDMS, are listed below.

1. Plots showing spider diagrams of the contaminant concentrations in soil, groundwater, surface water, and sediment that exceed standards/criteria (i.e., a call out box for each location showing the concentrations detected above the standards/criteria at each depth at each location). If a significant number of compounds are detected above standards/criteria, only selected compounds (e.g., the selected COPCs or a subset of these) will be plotted. The following plots will be considered for preparation for each sampled medium, if appropriate, based on the analytical results: VOCs, SVOCs, pesticides, PCBs, and metals.
2. Plots showing isoconcentration contour maps of total concentrations. The following plots will be considered for preparation, if appropriate, based on the analytical results: VOCs, SVOCs, pesticides, PCBs, and selected metals in soil above the peat; VOCs, SVOCs and selected metals in groundwater above the peat.
3. LNAPL thickness contour map for each of the three product thickness measurement events.
4. Groundwater elevation contour maps for the groundwater above the peat and for the groundwater below the peat for each of the three groundwater level measurement events.
5. Two geologic cross sections of the site and two fence diagrams. In order to minimize revisions of these deliverables, the borings through which the two cross-section lines will pass, will be first hand-marked on the site plan and provided to EPA for review and approval. The lines will be finalized based on EPA's comments and provided to the Lead for preparation of the geologic cross sections.
6. Boring logs for 37 borings and well construction diagrams for 19 wells.

All plots will be prepared as 11x17 drawings. The Leads will provide drafts of the plots to the PM and RI Lead for review and approval before the final plots are generated.

7. All boring logs and well construction diagrams will be entered into RIDMS. The Data Manager will provide drafts of these to the PM and RI Lead for review and approval before the final are generated.

Data flow for Diamond Head Oil Site

Sample tracking will be performed by PM or her designee located in CH2M HILL's New Jersey office (NJO) and database management (data entry and outputs) will be performed by the Data Manager and Leads located in CH2M HILL's Reston, Virginia office (WDC). The flow of data collected during the Phase 1 RI is as follows:

1. RI Lead provides weekly copies of the COC forms to the PM. PM or her designee completes the sample tracking table.

2. Data Manager sets the RIDMS.
3. PM or RI Lead provides Data Manager with:
   - Excel spreadsheet containing vertical elevations and horizontal coordinates for all sampling locations and groundwater elevations and product thickness measurements, and
   - Access-based tools containing the boring logs and well construction diagrams.
4. PM or her designee keeps in contact with EPA on status of sample analysis and data validation.
5. PM receives data packages. PM or her designee records the received validated data packages (hardcopy and EDD) in the sample tracking table.
6. PM or her designee reviews packages for completeness and determines if there are any issues that require further determination from EPA's RSCC. PM responsible for contacting the RSCC with any such issues,.
7. Data packages determined to be complete (hardcopy and EDD) along with the updated sample tracking table are sent to Data Manager in two events. With each shipment, the PM or her designee will indicate the samples whose data entry into RIDMS will be QC-ed.
8. Data Manager will supervise data entry and import.
9. Lead Risk Assessors provides Data Manager with list of needed risk assessment statistical calculations.
10. Data Manager provides statistical results to Lead Risk Assessors.
11. Lead Risk Assessors select COPCs and provide action levels (standards and criteria to use) and COPCs to PM.
12. PM and RI Lead review these and communicate the standards and criteria recommended for use to the EPA Project Manager for approval. Upon receiving EPA approval, the PM and RI Lead identify all inputs still needed in order to prepare the tables and plots (e.g., compounds to include in calculating totals, compounds to show on plots; these may include all or a subset of the COPCs). PM provides inputs and list of standards and criteria approved for use by EPA to Data Manager.
13. Data Manager and Leads generate draft tables and plots.
14. PM and RI Lead review and provide comments on draft tables and plots.
15. Data Manager and Leads generate final tables and plots.

Exhib[redacted]
Laboratory Tracking Information for Samples Collected during the Remedial Investigation Activities at the Diamond Head Oil Site
Diamond Head Oil Site RI/FS

Station ID	Sample ID	CLP Sample Number	Duplicate CLP Sample Number	Sample Matrix	Sample Type	Composite Yes or No	Sampling Method	Depth of Sample Top	Depth of Sample Bottom	Units	Sample Date	Sample Time	COC Date	Analyses	Case Number	Data received validated results	Comments
Subsurface Soil Samples - Borhole Sampling																	
Example																	
SB-25	SB-25-00-02-1	B0EP0/ MB0D54		SO	N	Y	Encore	0	2	ft	11/26/2001	14:10	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-10-12-1	B0EY7/ MB0D48	B0F18/ MB0D49	SO	N	Y	Encore	10	12	ft	11/26/2001	14:26	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-10-12-D-1	B0F18/ MB0D49		SO	FD	Y	Encore	10	12	ft	11/26/2001	14:26	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-20-22-1	B0EZ3/ MB0D50		SO	N	Y	Encore	20	22	ft	11/26/2001	15:40	05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30028		
SB-25	SB-25-20-22-1	B0EZ3MS/B0EZ3MS		MSD	N	Y	Encore	20	22	ft	11/26/2001	15:40	05/26/2003	TCL VOC, SVOC, pesticides/PCBs	30028		
Groundwater Samples from Monitoring Wells																	
Example																	
MW-5S	MW-5S-1	BOFA6/MBODZ1	BOFA7/MBODZ2	WG	N	N	Centrifugal Pump			ft	07/16/2002	09:40	06/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30707		
MW-5S	MW-5S-D-1	BOFA7/MBODZ2		WG	FD	N	Centrifugal Pump			ft	07/16/2002	09:40	06/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30707		
Surface Water																	
Example																	
SW-25	SW-25-1	BOFA7/MBODZ2		SW	N	N	Hand	NA	NA	NA			07/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30708		
Sediment																	
Example																	
SD-25	SD-25-1	BOFA8/MBODZ3		SD	N	N	Auger	NA	NA	NA			05/26/2003	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	30708		
Free Product																	
Waste Water and Solid Waste																	
Potable Tank, Fire Hydrant and De-Ionized Water Samples																	
Equipment and Trip Blanks																	
Example																	
	F-1-05-05-03	B0EN9/ MB0DS9		W	EB	N					11/03/2001	09:55	11/5/2001	TCL VOC, SVOC, pesticides/PCBs, TAL Total Metals	29935		
	T-1-05-05-03	B0ER0		W	TB	N					11/03/2001	09:50	11/5/2001	TCL VOC	29935		

Legend

SO	Soil sample	N	Normal media sample
MS/MSD	Matrix spike and duplicate	FD	Field duplicate
SL	Sludge sample	EB	Equipment blank
WG	Groundwater sample	TB	Trip blank
SW	Surface water	TCL VOC	Target compound list - volatile organic compounds
SD	Sediment	TCL SVOC	Target compound list - semi volatile organic compounds
FP	Free product	TAL Total Metals	Target analyte list for total metals
WW	Waste water		
IDW	Water sample from sources other than groundwater		
W	Water sample for field and trip blanks		
WZ	Water sample from sources other than groundwater		

ATTACHMENT E

Procurement Plan for Non-CLP Analyses Laboratories

ATTACHMENT E
Procurement Plan For the Analyses of Samples Outside of EPA's Contract Laboratory Program

The purpose of this attachment is to describe the procedures, which CH2M HILL will follow to procure laboratories for the analyses of samples outside of EPA's Contract Laboratory Program. Laboratories outside of the CLP will be used only for the analyses, which are not available through CLP. This procurement plan is for the analytical methods and samples described in the Diamond Head Oil site QAPP and SAP.

Procurement will consist of the following:

- CH2M HILL will prepare Statements of Work (SOWs) for all the analyses listed in the QAPP and SAP as not available through CLP. The SOWs will describe, as appropriate, the analytical methods, data deliverable requirements, QC requirements, estimated number of samples, schedule, and restrictions for the analyses. The SOWs will also incorporate the QC limits for each parameter and analytical method specified in the QAPP and SAP. Final data packages will be requested on a 28 work day turn-around-time.

- The SOWs will be combined with CH2M HILL's appropriate contractual agreements in a bid request package. This will ensure compliance with contractual policies and procedures under the Federal Acquisition Regulations.

- The bid request package will instruct the potential vendors to submit a bid on all or any portion of the requested analyses. The bid request package will require submittal of unit prices for all analyses selected by the vendor.

- The bid request package will be approved by CH2M HILL's Project Manager and Project Chemist.

- Potential laboratories will be solicited from the following lists:

  EPA Contract Laboratory Program (CLP): CLP participants include those laboratories within CLP, which also provide the analyses required for this project, which are not available through CLP.

  Specialty Analytical Services Providers: This list includes laboratories known by CH2M HILL for performing the required analyses. This list will include laboratories that have previously successfully performed these analyses for CH2M HILL

- Bids will be solicited only from laboratory services vendors that hold New Jersey Certification.

- Bid request packages covering all analyses will be sent to no less than three (3) candidate laboratory services vendors. For amounts less than $10,000, sole-source subcontracts may be issued. CH2M HILL has received government approval for a revision to CH2M HILL's Procurement System that raises the *competitive threshold* for federal procurements from $2,500 to $10,000. This new threshold is called the Federal Acquisition Streamlined Threshold (FAST). FAST Procurements are those federal procurements below $10,000 which may be made without a competitive source selection process. The objective is to streamline the procurement process and reduce procurement costs.

- CH2M HILL will receive the laboratory bids and perform an initial screening for completeness. All incomplete laboratory bids will be immediately rejected.

- Laboratory bids that pass the initial screening will be sorted according to parameter.

- CH2M HILL will review the technical completeness of the bids. This includes review, as appropriate, of the submitted laboratory credentials, applicable sections of QA manuals, applicable SOPs, key personnel resumes, facilities and prior applicable PE results. Each item will be evaluated as acceptable or not acceptable.

- CH2M HILL will reject laboratory bids that do not have appropriate credentials, acceptable QA manuals, applicable SOPs, or acceptable PE results. In addition, CH2M HILL will reject any laboratory(ies) that are unable to meet the QC criteria specified in each analytical services SOW request. Each laboratory vendor(s) must receive an "Acceptable" evaluation on all items to be retained for further consideration.

- CH2M HILL will perform a cost evaluation of each laboratory considered capable of meeting the criteria set forth in the bid request package.

- Based on the best value to the government, CH2M HILL will select one or more laboratories to perform the required Non-RAS analyses.

- CH2M HILL will submit to the EPA Contracting Officer, Project Officer, and Work Assignment Manager a recommendation(s) for appropriate laboratory service vendor(s).

- After receiving appropriate EPA approval, CH2M HILL will award a subcontract(s) to the laboratory service vendor(s).